Int.J.Curr.Microbiol.App.Sci (2021) *10*(05): 695-701

International Journal of Current Microbiology and Applied Sciences
***ISSN: 2319-7706* Volume 10 Number 05 (2021)**
Journal homepage: http://www.ijcmas.com

Original Research Article https://doi.org/10.20546/ijcmas.2021.1005.077

Impact of Weather Behaviour on Pigeon Pea Productivity in Prakasam District of Andhra Pradesh in India

M. Satya Swarupa Rani*, N. V. V. S Durga Prasad and G. Ramesh

Krishi Vigyan Kendra, Darsi, Prakasam District, Andhra Pradesh, India

**Corresponding author*

Keywords

Rainfall, Redgram, Yield, Weather response, Technology effect

Article Info

Accepted:
22 April 2021
Available Online:
10 May 2021

A B S T R A C T

Rainfall is one of the key component of meteorological parameter that influence crop production. Here, the distribution of rainfall studied by Pearsonian coefficient to the rainfall data recorded over 30 years (1990-2020) for the Prakasam district. In this context crop yield –weather relations, is requisite to account for the influence of improved technology on the crop yields. Analysis has been carried by using 30 year (1990 - 2020) weather data and yields of Redgram. In this study, the concept of continuous time effect in the crop yields in contrast to introducing a discrete-time effect (technology effect) using *Kharif* yields to Red gram in the Prakasam district. The *kharif* redgram yield data of 30 years (1990 - 2020) used for the study. Inter annual variability is extensively considered amongst the wide range of time scales. An attempt to estimate decadal analysis by dividing the 30 years in to 3 subperiods each sub period as 10 year identified as relevant. This evokes to examine the individual crop yield –weather relationship corresponding to the technological sub periods is essential for weather response with crop growth stages.

Introduction

Primarly crop yield can be determined by various abiotic and biotic factors like climate, crop management practices, pest and nutrients available in the soil. Any crop variety may be subjected to environmental conditions and abiotic factor like stress also act as physical harm to plant. illustrating that plant growth, development and the productivity depends on it (Summy Yadav *et al.*, 2020).Weather plays a major role in determining the success of agricultural pursuits. Most field crops are dependent solely upon weather to provide life-sustaining water and energy (Kevin C. Vining,1990). Climate and weather may effect crop production in multiple ways. If a weather event that is fatal to crops takes place during the crop growth period, is an indicator of the impact of the fatal event may be more relevant

than that of growing-season mean climate to explain variations in crop production in that year (Toshichika lizumi, and Navin Ramankutt, 2015).

Pulses have significant influence in Indian agriculture as they are hidden supply of protein, which is cost effective than other protein rich food like meat, dairy products. They are most used up in finding a solution for protein malnutrition and also used as fodder and concentrates in cattle feeds. Pigeon pea is one of the major pulse crop in tropics and subtropics, its ability to bring forth economic yields under scarce rainfall conditions, contributes a substituent crop of dry land agriculture. World wide production statistics is about 5.6 million hectares with a production and productivity of 4.42 million tons and 751 kg/ha, respectively. India tops first in production (74.9 %) follows other countries Malawi (10.50%), Myanmar (7.8%), united states of Tanzania(2.03%), Kenya (1.98%) (FAO, 2019) In India, major area is lying between 14˚ and 28˚ N latitude, where the majority of the world's pigeonpea is produced (FAO, 2019). Rainfall is one of the meteorological parameter that influence crop production in particular and agriculture in general. The parameters such as amount, intensity, spread of rainfall and number of rainy days are being used to characterize rainfall in a district or in a zone. Among these, rainfall distribution has been found to have profound effect on crop performance in rainfed agriculture. Modern agriculture requires precise information on rainfall to plan the most effective cropping pattern. In Prakasam district, having 17,62,600 hectares of total geographical area, out of which 35.6 % contributes net cropped area is 6,05,169 hectares. out of this in *kharif*, Redgram ranks first in cropping area is about 98,086 hectares (Des, 2020) present study was taken to study the impact of weather on productivity of pigeon pea.

Materials and Methods

Present study was conducted to identify distribution of rainfall in prakasam district by pearsonian approach. This approach is based on calculating the measure, which is popularly known as constant K. On the basis of range of K Pearson distributed some distributions

Rainfall distribution over an area in this study can be studied by fitting a distribution function, we can extract the probabilistic information of the random variable Fitting distribution can be achieved by the method of moments and the method of maximum likelihood. Karl pearson 1916considered that good estimate of the parameters of a probability distribution are those for which moments of the probability density function about the origin are equal to the corresponding moments of the sample data.

$$\mathbf{K} = \frac{\beta 1(\beta 2+3)}{4(2\beta-3\beta-6)(4\beta 2-3\beta 1)} \quad \mathbf{(1)}$$

$\sqrt{\beta}\ \mathbf{1}$= **Skewness,** $\beta 2 = kurtosis$

Crop yield-weather relations

To measure time effect, this also accounts for the technological bounce on crop yields. The approach generally followed is to fitting of suitable trend equation to crop yield data This approach is suitable when fluctuations in the crop yield are of continuous nature. The time effect in the crop yields is the outcome of several factors such as technological innovations in the crop that are released time to time in addition to weather effect.

Crop yield-weather analysis has a 200 years old history despite of this; the advancement in this field has been passive in the past because of lack of suitable data and the complexity of the analysis of the interactions between crop-soil-weather variables (Baier, 1973). To obtain

data suitably for such analysis, physical experimental and empirical-statistical approaches are commonly used. "Crop-weather models may be defined as a simplified representation of the complex relationship between weather or climate on one hand and crop performance (Such as growth, yield (or) yield components) on the other hand by using established mathematical and /or statistical techniques (Baier, 1979). Baier (1979) classified crop yield – weather models into three categories.

Mechanistic type crop growth simulators

Statistically based crop –weather analysis models providing a running account of the accumulated (daily) crop responses to selected Agrometeorological variables as a function of time (or) by crop development and multiple regression yield models, in which one or several variables representing weather or climate, soil characteristics or a time trend are statistically related mostly to several yields or other crop statistics.

Suryanarayana *et al.*, (1988) have analysed rainfall trends in Bijapur region and indicated that stage-wise estimation of weather effects looses its significance because the information about the crop calendar could be available only approximately. The procedures generally applied for estimating the relationships are :

The Fisher's procedure (b) Multiple regression analysis Fisher's procedure: Fisher's (1924) approach is one of the earliest procedures for obtaining crop weather relationship.

Basically, the technique was applied to study the impact of rainfall on crop yields. The technique is meant to take into account not only the total amount of rainfall during a certain period but also the manner in which it is distributed over the period under consideration. The basic relation between yield (y) and a meteorological factor (w) can be stated as :

$$Y = a0 + a1w1 + \ldots\ldots anwn \quad \ldots(2)$$

Where, the w's are the values of weather factor in the `n' periods and the period represents equal sub-division of the total period over which the effect of the weather factor is to be studied

Results and Discussion

Present study was focused to study the rainfall distribution over the 30 years (1990 – 2020) of Prakasam district. by using Pearsonian approach(K) it is know that in first sub period it followed type IV *kharif* season and type 6 in *rabi* season, in second period it followed type Iand type IV distribution *kharif* and *rabi* respectively in third subperiod it followed typeIdistribution in *kharif* and *rabi* respectively.

Pigeon pea is selected for estimating the seasonal behaviour in terms of rainfall to yield analysis In Prakasam district pigeon pea window of sowing is between July to August and harvested during January month. The overall average yield of pigeon pea is about 468.9 kg / ha covering 30 years (1990 – 2020).To improve the accuracy the data is divided in to 3 decades i.e., 1990 – 2000 as sub period -I, 2001 – 2010 as subperiod -II, 2011- 2020 as sub period - III.

By computing these sub periods in terms of pigeon pea yields. by using descriptive statistics ie., mean, standard of deviation, coefficient of variation of pigeon pea yield analysis are shown in the table 1.

From the table 3, three subperiods observed same coefficient of variation values 26.8 %, 23.41%, 27.8 %. In case of standard deviation for the sub period 3 shows a value of 137.2 it

is higher than the remaining 2 sub periods. This represents there is a possibility of differential weather response by the crop.

Time trend analysis can be studied by control charts using either σ or 2 σ or 3 σ limits In present study, these effects were obtained by using σ limits which represents upper control limits (X +σ) and lower control limits (X - σ).these limits for the period were tabulated below

From table 4, conclude that by using control charts yields with in this each subperiod were randomly scattered from the mean value.

By investigation of existing discrete time effect, redgram yield in contrast to continuous trend. it can be observed that linear regression was applied for redgram yield.

From table 5 sub period 2 is having highest R value, represents highest regression can be during sub period II(2001 – 2010). It shows highest average yield is observed in this subperiod.

From table 6, SWRF represents south west rainfall, Y represents yield of the crop, a trend equation is calculated for Redgram Crop yields and weather (total seasonal rainfall) relationship was developed separately for the sub period I, sub period II, sub periodIII by fitting multiple regression equations. For screening the independent variables with step wise regression.

Kharif red gram assumes to get vegetative period during August – October (kharif season) in this phase, mean rainfall is sufficient for growth and development.

During September to November the relative humidity show some conducive effect results in pest and disease attack a favourable wet conditions. In the crop yield weather relationship for overall periods regressors found were time trend (positively related). These weather variables showed different from those of the subperiods. Hence the relationship obtained with overall data may not be reason for estimation of yields.

Abiotic factors play a major role in relationship between crop growth and its productivity. The relationship between crop productivity and weather help in assessing the growth and productivity at various stages of crop and in quantifying the stress – yield relation in respect of moisture, thermal and radiation regimes (Puppala vijaya kumar 1999).

Weather act as a leading role in deciding the agricultural operation from field preparation to harvesting. These can be understood by crop weather relationships.

Present study aims to study the rainfall distribution over the Prakasam district and weather parametres on redgram yield over 30 years (1990 – 2020).

Initially rainfall distribution is calculated by pearsonian approach from this approach during 3 sub periods (1990 – 2020) first sub period (1990 – 2000) follows type 4 and type 6 in *kharif* and *rabi* respectively.

In second sub period (2000 – 2010) follows type 1 and type 4 (normal) distribution. In third sub period (2010 – 2020) follows type 4 and type 1 in *kharif* and *rabi* season.

Mohita *et al.*, (2010) used log normal and gamma distribution for annual and seasonal period of study. Second objective is to study the impact of rainfall on redgram yield, for this time series analysis using multiple regression was used, it showed r value greater than 0.80 indicates there is good relation ship between yield and weather parameter.

Table.1 Reference: Advanced theory of statistics vol 1 and 2 by m. Kendall and R. Stuart, Griffin publishers

S.no.	Range of constant K	Type / name of the distribution
1	K < 0	Type I distribution
2	K > 1	K TypeVI distribution
3	0 < K 1	Type IVdistribution
4	K α 1	Type III distribution
5	K = 1	TypeV distribution
6	K = 0	Type II distribution

Table.2 Rainfall mean values of kharif and rabi seasons in Prakasam district

	Sub period I (1990 – 2000)		**Sub period II (2001 – 2010)**		**Sub period III (2011 -2020)**	
	Kharif	Rabi	Kharif	Rabi	Kharif	Rabi
Mean	396.6	465.5	371.9	291.9	368	251.5
Standard deviation	110	127	146.8	111.4	121.6	134.6
Coefficient of variation	27.7	27.2	39.4	38.1	33.04	53.4
K(Pearsonian coefficient)	1.5	-0.92	0.17	0.0	0.0	0.0

Table.3 Mean yield of Redgram (kg/ha) for 3 sub periods of Prakasam district

Period of relationship	**Mean**	**SD**	**CV**
Sub period I (1990 – 2000)	462.5	124.2	26.8
Sub period II (2001 – 2010)	445.1	104.2	23.41
Sub period III (2011 -2020)	499.2	137.2	27.8
overall	468.9	120.5	25.6

Table.4 Control limits of Redgram (kg /ha) yields of Prakasam district

Control limits	**Sub period 1**	**Sun period 2**	**Sub period 3**
Upper control limit	586.7	549.3	636.4
Lower control limit	338.3	340.9	362

Table.**5** Trend equation for redgram yields in different sub periods in Prakasam district.

Period of relationship	Equation	R^2
Sub periodI(1990 – 2000)	Y =544.6 - 14.96 x	0.13
Sub period II(2001 – 2010)	Y= 575.73 – 23.75x	0.47
Sub period III(2011 -2020)	Y= 656.13 – 28.53x	0.39

Table.**6** Crop yield – weather relationship in Prakasam district.

Period of relationship	Equation	R^2
Sub period I(1990 – 2000)	Y = -0.65 + 0.55x SWRF	0.80
Sub period II(2001 – 2010)	Y=307.79 + 21x SWRF	0.82
Sub period III(2011 -2020)	Y=257.74 + 0.38x SWRF	0.84

Table.**7** Monthly average Relative humidity values

Relative Humidity	Sub Period 1 Relative Humidity	Sub Period 2 Relative Humidity	Sub Period 3 Relative Humidity
JUL	67.58545	66.436	63.49
AUG	72.05364	72.326	69.47333
SEP	75.37909	77.361	75.22111
OCT	**80.31909**	**79.144**	**73.75778**
NOV	**79.55545**	**79.954**	**73.10556**
DEC	74.22545	74.295	68.49889
JAN	65.23091	67.097	60.08889
FEB	53.73182	54.717	50.94444

A study conducted by (David b lobell and christpher b field 2007) regression act as good probability statistics to study the Modern agriculture require precise information on weather parameters over the ecological zone to plan the most effective cropping patterns and nature of trend is to be examined before formulating the crop yield weather relationship on an average new varieties yielding more than old varieties followed in the district.

References

Agarwal, R., Jain, R. C. and Jha, M. P. 1986.Models for Studying Rice Crop-Weather Relationship. Mausam, 37, 67-70.

Baier W. 1973. Crop weather analysis model. International Journal of Biometeology. 17(4) : 313 – 320

Baier W. 1979. Note on terminology of crop weather models. Agricultural meteorology.1979. 20: 137

David B Lobell, Christopher B Field., 2007. Global scale climate–crop yield relationships and the impacts of recent warming. Environmental research letters vol 2 :1

Directorate of economics and statistics, Andhra Pradesh FAO.2019

Fisher.1924. Influence of rainfall on the yield of wheat at rothemsted. Philosophical transactions of the royal society of london series B.1924. 213:89 -142

Karl Pearson. 1916. Mathematical contributions to the theory of evolution, XIX: Second supplement to

a memoir on skew variation. Philosophical Transactions of the Royal Society A. 216 (538–548): 429–457

Kevin C.vining.1990.Effect of weather on agricultural crops and livestock : an overview. International journal of Environmental studies.vol 36:Issue (1 – 2)

Mohita Anand Sharma and Jai Bhagwan Singh.2010.Use of Probability Distribution in Rainfall Analysis. New york Science Journal.Vol 3 (9).

Summy Yadav, Payal Modi, Akanksha Dave, Akdasbanu Vijapura, Disha Patel and Mohini Patel., 2020.Sustainable crop producton.Effect of abiotic stresses on crops book. Available: DOI: 10.5772/intechopen.88434. Research in India pp: 211 - 226

Shalender kumar, Raju B M K, Ramarao C A, Kareemulla K, Venkateswarlu B. 2011., Sensitivity of yields of major rainfed crops to climate in India. Indian Journal of Agricultural Economics. Vol 66(3): 340.

Suryanarayana G, Gopinatha rao M, Itnal C J, and Mageri S J. 1988.Trends in rainfall around bijapur. Mysore Journal of Agricultural Sciences 22:83

Toshichika lizumi, Navin ramankutty.2015. How do weather, climate influence cropping area and intensity?.Global food security. Vol(4):46 – 50.

Vijaya kumar. P, Ramakrishna Y. S, Ramana rao B. V, Khandgonda I. R, Victor U. S, Srinivastava N N, Rao G G S N.,1999. Assessment of plant-extractable soil water in castor beans (*Ricinus communis L.*) using infrared thermometry.vol 39(1): 69 – 83.

How to cite this article:

Satya Swarupa Rani, M., N. V. V. S Durga Prasad and Ramesh, G. 2021. Impact of Weather Behaviour on Pigeon Pea Productivity in Prakasam District of Andhra Pradesh in India. *Int.J.Curr.Microbiol.App.Sci.* 10(05): 695-701. doi: https://doi.org/10.20546/ijcmas.2021.1005.077