Journal of Pharmacognosy and Phytochemistry
Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
www.phytojournal.com
JPP 2020; Sp 9(5): 123-125
Received: 09-07-2020
Accepted: 11-08-2020

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Trend and growth performance of gram in Central region of Uttar Pradesh

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Abstract
Agriculture is the primary source of livelihood for about 58 per cent of India's population. Uttar Pradesh (UP) located in northern part of India is surrounded by Uttarakhand, Himachal Pradesh, Haryana, Delhi in the North and in west Rajasthan, Madhya Pradesh and Chhattisgarh in the South -West and South; and Jharkhand and Bihar in the East. It is the fifth largest state in India in terms of geographical area covering roughly 240,928 square kilometers. This is nearly 7.33 percent of total area of the country.UP is generally divided into 4 zones or regions- Western, Central, Eastern, Bundelkhand. The time series data pertaining to period from 1997-98 to 2016-17 on area, production and productivity of Gram in central region of U.P. Therefore, the time series data to study the growth pattern of the area, production and productivity of gram in central region. Annual average simple and compound growth rates of area, production and productivity of gram in central region of Uttar Pradesh during the period of (1997-98 to 2016-17) having in negative trend**.** Simple Growth rate of area obtained in decreasing trend -1.9494 per cent, production decreases at the rate of -2.85627 and productivity decreases at the rate of - 0.39616. Compound Growth rate of area obtained in decreasing trend -1.87812 per cent, production decreases at the rate of -3.90963 and productivity decreases at the rate of-0.94336.The present study pertaining in 2019-20," titled Trend and growth performance of gram in Central region of Uttar Pradesh.

Keywords: Trend, growth performance, simple growth rate, compound growth rate

Introduction
Agriculture is the primary source of livelihood for about 58 per cent of India's population. India is the world's largest producer of many fresh fruits, vegetables, milk, major spices, fresh meat, fibrous crops like jute and staple crops such as millets and castor oil seeds. Uttar Pradesh (UP) located in northern part of India is surrounded by Uttarakhand, Himachal Pradesh, Haryana, Delhi in the North and in west Rajasthan, Madhya Pradesh and Chhattisgarh in the South -West and South; and Jharkhand and Bihar in the East. It is the fifth largest state in India in terms of geographical area covering roughly 240,928 square kilometers. This is nearly 7.33 percent of total area of the country.UP is generally divided into 4 zones or regions- Western, Central, Eastern, Bundelkhand. An earlier state government in 2011, had recommended breaking up of UP into 4 smaller states namely, Paschim Pradesh, Awadh Pradesh, Purvanchal and Bundelkhand, broadly based on the regions In order to develop strategic research and development for increasing agricultural production, India has been divided into 127 agro climatic zones based on soil, climate and other agro meteorological characteristics under the National Agricultural Research Project (NARP) undertaken by the erstwhile Planning Commission of these 127 zones, 9 agro climatic zones have been recognized in the state of UP, namely:-Tarai, Western Plain(W.P)Mid – Western Plain (MWP),South-Western Semi, Mid Plain (MP), Bundelkhand, North Eastern Plain (NEP),Eastern Plain (EP), Vindhyan. The state produces 31.60% of the nation's cereals. Main production in the state are Potato Sugar, and oil seeds, beside these wheat, gram, rice, bajra barley and maize are also produced at large scale. The Rabi Crop includes Wheat, Barley, Gram, Mustard and Potato etc. the present study Obtain Growth rates of area, production, productivity of gram in central region of Uttar Pradesh.

Methods and Materials
Methods and Materials involved statistical methodologies to carry out the investigation undertaken, in order to study the trend and growth rate of area, production and productivity of gram in Central region of Uttar Pradesh. Some appropriate statistical methodologies have been used.

Materials:
The time series data pertaining to the period from 1997-98 to 2016-17 on area, production and productivity of Gram in central region of U.P., have been used to study the growth trends. These time series data have been procured from the Bulletins of Directorate of Agricultural Statistics and Crop-Insurance, Krishi Bhawan, Lucknow, Government of Uttar Pradesh and websites like updes.up.in/spatrika and agricoop.nic.in/agristatisticsnew.htm. A lot of efforts are made by the Government of India to improve the scenario of different crops production in the country in the past. Therefore, the time series data to study the growth pattern of the area, production and productivity of gram in central region.

Statistical Methodologies
Regional Total
Sum of all districts data under particular region in the particular year.

Moving Average
A moving average of order mm can be written as,

$$\hat{T}_t = \frac{1}{m}\sum_{j=-k}^{k} y_t + j,$$

Where m=2k+1That is, the estimate of the trend-cycle at time t is obtained by averaging values of the time series within k periods of t. Observations that are nearby in time are also likely to be close in value. Therefore, the average eliminates some of the randomness in the data, leaving a smooth trend-cycle component. We call this an m-MA, meaning a moving average of order m.

Trend and growth rate
The trend and growth rate in area, production and productivity of different food grain crops have been worked out by fitting the following five different functions:

1. Simple linear function

$Y_t = a + b_t + \mu_t$

2. Compound function

$Y_t = a_t (1+r)^t \mu_t$

Where,
Y_t: Time series data on area/production/productivity of Gram at time t, a & b are parameters of the function to be estimated.
t: Time index (t= 1,2,…..n)
r: Average compound growth rate per annum.
μ_t : error term at t and is assumed to follow independently distributed
However, before the fitting above functions, the time series data on area and production were smoothed by three years moving-average method.

Computation of growth rate
1. For linear function
After fitting the linear trend function by least-square method, we get the estimate of b denoted by $\hat{b}$ (say). Then, annual linear growth rate is computed as follows

$$r = \frac{\hat{b}}{\overline{Y}} \times 100$$

Where, $\overline{Y}$ is arithmetic mean of Y_t.

2. Compound growth rate
To obtain annual compound growth rate, the third function was first linearised by taking natural log on both side, i.e.

$\log Y_t = \log a + t \log (1+r)$

or $Y_t^* = a^* + bt$

Where, Y_t^* =log Y_t, a* = log a and b= log (1+r)

The above linearized function was fitted by least square method and estimate of b as $\hat{b}$ was obtained.

The annual compound growth rate is then computed as

r = (antilog of $\hat{b}$ -1) x 100

Result and Discussion
Trend and growth rates in area, production and productivity of gram in central region of Uttar Pradesh
Annual growth rates of area, production and productivity of gram worked out using two functions, viz. simple and compound growth for central region of Uttar Pradesh. The results are presented and are discussed for gram crop in central region of U.P.

Table 1: Area, production and productivity of Gram in Central region of Uttar Pradesh

Year	Area	Mov av	Production	Mov av	Producti	Mov av
1997-98	138865		132772		7.54	
1998-99	132960	44320	140717	46905.67	8.157	2.719
1999-00	124308	41436	135710	45236.67	8.954	2.984667
2000-01	115621	38540.33	123035	41011.67	9.039	3.013
2001-02	107698	35899.33	121347	40449	9.049	3.016333
2002-03	108614	36204.67	131450	43816.67	9.286	3.095333
2003-04	104984	34994.67	124866	41622	8.85	2.95
2004-05	107594	35864.67	110488	36829.33	8.79	2.93
2005-06	109069	36356.33	133641	44547	10.866	3.622
2006-07	107815	35938.33	113408	37802.67	8.059	2.686333
2007-08	103500	34500	108099	36033	9.146	3.048667
2008-09	98151	32717	128390	42796.67	10.966	3.655333
2009-10	104863	34954.33	106605	35535	8.683	2.894333
2010-11	94647	31549	114051	38017	7.791	2.597
2011-12	97343	32447.67	136162	45387.33	12.772	4.257333
2012-13	96783	32261	124342	41447.33	12.054	4.018
2013-14	93598	31199.33	49895	16631.67	5.071	1.690333
2014-15	91104	30368	29373	9791	4.321	1.440333
2015-16	91104	30368	53199	17733	5.837	1.945667
2016-17	91104		123212		10.506	

Table-1: Shows area, production and productivity of gram in Central Region of Uttar Pradesh during the period of 1997-98 to 2016-17. Table- revealed that highest area (138865 ha), production (140717 mt) and productivity (12.772 qtl/ha) during the period of 1997-98, 1998-99 and 2011-12respectively, and minimum area of gram (91104 ha) during the periods of 2014-15 to 2016-17, minimum production

(29373 mt) in 2014-15; minimum productivity of gram (4.321 qtl/ha) in 2014-15.

Table 2: Annual average simple and compound growth rates of area, production and productivity of gram in central region of Uttar Pradesh (1997-98 to 2016-17).

Central	S.G.R	-1.94944	-2.85627	-0.39616
	C.G.R	-1.87812	-3.90963	-0.94336

Table 2 revealed that annual average simple and compound growth rates of area, production and productivity of gram in central region of Uttar Pradesh during the period of (1997-98 to 2016-17).The simple growth rate of area, production and productivity was negative trend. Simple Growth rate of area obtained in decreasing trend -1.9494 per cent, production decreases at the rate of -2.85627 and productivity decreases at the rate of - 0.39616. The simple growth rate of production and productivity decreases due to negative trend of area.
Table 2 also revealed that annual compound growth rates of area, production and productivity of gram in central region of Uttar Pradesh during the period of (1997-98 to 2016-17). The compound growth rate of area, production and productivity obtained in negative trend. Compound Growth rate of area obtained in decreasing trend -1.87812 per cent, production decreases at the rate of -3.90963 and productivity decreases at the rate of-0.94336.The simple growth rate of production and productivity decreases due to negative trend of area.

Summary and Conclusion

Highest area (138865 ha), production (140717 mt) and productivity (12.772 qtl/ha) obtained during the period of 1997-98, 1998-99 and 2011-12respectively, and minimum area of gram (91104 ha) during the periods of 2014-15 to 2016-17, minimum production (29373 mt) in 2014-15; minimum productivity of gram (4.321 qtl/ha) in 2014-15. Annual average simple and compound growth rates of area, production and productivity of gram in central region of Uttar Pradesh during the period of (1997-98 to 2016-17) having in negative trend**.** Simple Growth rate of area obtained in decreasing trend -1.9494 per cent, production decreases at the rate of -2.85627 and productivity decreases at the rate of -0.39616. Compound Growth rate of area obtained in decreasing trend -1.87812 per cent, production decreases at the rate of -3.90963 and productivity decreases at the rate of-0.94336.

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