| Research Paper |

Growth and instability of orange in India

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ABSTRACT : The growth of horticulture crops has become one of the driving forces for overall development of agricultural sector in India. With the emergence of urbanization and modernization, changes in cropping pattern from traditional to high value cash crops, especially the horticultural crops has been initiated in Indian agriculture. Keeping these understandings in mind, the present study estimates the growth rate and instability performance in area, production and productivity of Orange crops over years in India. The performance of Orange in India carried with the objective to study the growth and instability of area, production and productivity of oranges in India. The secondary data on area, production and productivity of orange were collected from database of National Horticultural Board, Ministry of Agriculture, Govt. of India. The data pertained to the period of 20 years *i.e.* from 1993-94 to 2012-13 during the study period data were divided in to four periods *viz.,* Period-I (1993-94 to 1997-98), Period-II (1998-99 to 2002-2003), Period-III (2003-04 to 2007-08), Period-IV (2008-09 to 2012-13) and overall period which termed as period-V (1993-94 to 2012-13). The growth and instability in area, production and productivity of orange in India, the highest instability was observed in period-I followed by period –III in area and production on period-II followed by period-III and productivity on period-III followed by period-II. The lowest instability was observed in period II on area and production on period-I and productivity on period-I. There was fluctuation or variability observed in time series data.

KEY WORDS : Orange, Growth, Instability

INTRODUCTION :

The horticulture sector is perhaps the most profitable venture of all farming activities (Mahesh *et al.*, 2000). The importance of horticulture in improving the productivity of the land, generating employment, improving economic conditions of the farmers and entrepreneurs, enhancing exports and above all, providing nutritional security to the desert dwellers, can hardly be overemphasized (Mittal, 2007 and Kondal, 2014). In 2013-14, horticulture sector's gross cropped area and production is 24.2 million hectares and 283.5 million tonnes, respectively. It contributes around 30 per cent to agriculture gross domestic product (GDP) of the country (Kumar, 2013). Fruits play a unique role in developing countries like India both in economic and social sphere for improving income and nutritional status particularly of rural masses (Nagraj, 1997) orange is the most important commercial citrus species in India. Orange is a fruit of excellence and exceptionally good nutritive value which is regarded as high source of Vit. C. the deficiency of Vit C. causes scurvy, tooth decay bleeding of gums.

Orange is consumed fresh or in the form consumed fresh or in the form of juice, jam and syrup. It is the main source of citric acid which has high value in international market. Citrus industry in India is the third largest fruit industry of the country after mango and banana agro industrial point of view. There are diversified forms of products such as preserves juices, beverages products. About one third citrus fruit production goes for processing. Orange which matures in February-March has great position for export. Orange is continuous source of income generation to the producer (Farmers). Keeping this view, there is a need to analyze the trends in orange crop and their instability.

MATERIALS AND METHODS :

In the present study, compound growth rate (CGR) of area, production and productivity for the orange crop was estimated to study the growth and trend apart from analyzing the district wise performance of crops. The compound growth rates are found very convenient for any comparison of growth between two periods. It seems more appreciable to analyze the movement of agricultural crops in terms of compound rather than linear growth rate (Dandekar, 1980 and Shadmehri, 2008). Hence, the compound growth rates are computed for the selected major crop in study area. The time series on area, production and productivity of orange in India were collected from published source Database of National Horticulture Board, Ministry of agricultural, Government of India (NBH). The data pretended to the period of 20 years *i.e.* from 1993-94 to 2012-13 during the study period data were divided in to four periods *viz.,* Period-I (1993-94 to 1997-98), Period-II (1998-99 to 2002-2003), Period-III (2003-04 to 2007-08), Period-IV (2008-09 to 2012-13) and overall period which termed as Period-V (1993-94 to 2012-13). The compound growth rate of area and production and productivity was computed using the following formula:

Linear trend equation:

$$\hat{y} = a + bt \qquad \qquad ......1$$

where,

$\hat{y}$ = Estimated area/production

t = Year

a = Intercept

b = Estimate of growth parameter

Semi log trend equation:

$$\hat{y} = ab^t \qquad \qquad ......2$$

Linear growth rate:

Over initial year $\left(b/\overline{X}\right) 100$

where,

b = Estimate of growth parameter

X = Base year area/production/yield.

Linear growth rate:

Over average $\left(b/\overline{X}\right) 100$

where,

b = Estimate of growth parameter

$\overline{X}$ = Arithmetic mean of area, production and yield.

From equation (2) *i.e.* CGR from semilog trend equation.

Compound growth rate :

The significance of the linear and compound growth rates was tested with the help of correlation co-efficient (r) by using 't' test:

$$t = \frac{r}{\sqrt{\frac{1-r^2}{n-2}}},$$

where,

n – Number of observations

The linear or semi log trend was better fit according to the significance of r and significance of b.

Co-efficienct of variation (CV) :

CV is percentage variation in mean whereas, standard deviation is considered as total variation in the mean:

$$C.V. = \frac{\sigma}{X} \times 100$$

whereas,

Σ standard deviation distribution with smaller cv is said to be more homogenous or more uniform or less variable than the other and series with greater cv is said to be heterogeneous or more variable than the other.

Cuddy and della instability index (CVT) :

The co-efficient of variation is generally used a measure of instability. But time series data often contain a trend component. In order to take care of this trend component and for meaningful measurement of instability, CV is modified as proposed by Cuddy and Della instability

index given by formula:

$$Cvt = CV\sqrt{1-r^2}$$

where, CV = Co-efficient of variation

r² = Co-efficient of determination trend

A linear trend was fitted to a time series data on area, production and productivity.

RESULTS AND DATA ANALYSIS :

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Growth and instability in area of orange in India (Period 1993-94 to 2012-13):
Linear trend:

Growth and instability in area of orange in India was studied and presented in (Table 1). Area of orange in India during study period, the highest area of orange was observed in period-II (2010.05 thousand hectares),

followed by overall period-III (184.11 thousand hectares) and the lowest area of orange was observed in period-I (158.17 thousand hectares).

As far as instability is concerned, the highest instability was observed in overall period-III (13.09%) and the lowest instability was observed in period-II (11.02%). Area of orange in India for period-II and period-III, it was positive and significant at 1 per cent level. In the semi log trend, during the study period, the highest compound growth rate was observed in period-II (5.10%), followed by period-III (3.03%) and the lowest compound growth rate was observed in period-I (2.29 per cent). In period-II and period-III it was positive and significant at 1 per cent level (Table 1).

Growth and instability in production of oranges in India (Period 1993-94 to 2012-13):
Linear trend :

Growth and instability in production of orange in India for period (1993-94 to 2012-13) was studied and presented in (Table 2). The highest production of orange

Table 1: Growth and instability in area of orange in India

Period	a	b	r	Growth rate over initial year (%)	Growth rate over average year (%)	Mean (000 ha)	CGR	CV (%)	Instability (%)
Period–I (1993-94 to 2002-03)	138.69	3.54	0.456	2.55	2.23	158.17	2.29	14.86	13.23
Period-II (2002-03 to 2012-13)	152.95	10.38	0.805**	6.78	4.94	210.05	5.10	18.57	11.02
Period-III (1993-94 to 2012-13)	125.01	5.62	0.810**	4.50	3.05	184.11	3.03	22.34	13.09

** indicate significant of value at P=0.01

Table 2 : Growth and instability in production of orange in India

Period	a	b	r	Growth rate over initial year (%)	Growth rate over average year (%)	Mean (000 MT)	CGR	CV (%)	Instability (%)
Period–I (1993-94 to 2002-03)	966.66	68.32	0.746*	7.06	5.08	1342.46	5.29	20.65	13.75
Period-II (2002-03 to 2012-13)	847.68	143.46	0.686*	10.92	8.56	1636.75	7.68	38.68	28.14
Period-III (1993-94 to 2012-13)	981.38	48.40	0.574*	4.93	3.24	1489.60	2.85	33.50	27.43

* indicate significance of value at P=0.05

Table 3 : Growth and instability in productivity of orange in India

Period	a	b	r	Growth rate over initial year (%)	Growth rate over average year (%)	Mean (000 MT/ha)	CGR	CV (%)	Instability (%)
Period–I (1993-94 to 2002-03)	7.16	0.23	0.563	3.30	0.55	8.47	3.05	15.04	12.43
Period-II (2002-03 to 2012-13)	7.00	0.06	0.170	0.91	0.87	7.35	0.64	15.40	15.18
Period-III (1993-94 to 2012-13)	8.40	-0.04	-0.212	-0.55	0.59	7.91	-0.60	16.91	16.14

* indicate significance of value at P=0.05

in India was noticed during period-II (1636.75 metric tonnes), followed by period-III (1489.60 metric tonnes) and the lowest production of orange was observed in period-I (1342.46 metric tonnes).

The highest instability in production of orange was observed in period-II (28.14 %), followed by period-III (27.43%) and the lowest instability was observed in period-I (13.75%). Production of orange in India for period-I, II and III, it was positive and significant at 5 per cent level. In the semi log trend, during the study period, the highest compound growth rate was observed in period-II (7.68%), followed by period-I (5.29%) and the lowest compound growth rate observed in period-III (2.85 %). In period-I and II it was positive and significant at 5 per cent level (Table 2).

Growth and instability in productivity of oranges in India (Period 1993-94 to 2012-13):
Linear trend:

Growth and instability in productivity of orange in India during period 1993-94 to 2012-13 was studied and presented in (Table 3). Productivity of orange in India during studied period (1993-94 to 2012-13), the highest productivity was observed in period-I (8.47 metric tonnes per hectare), followed by period-III (7.91 metric tonnes per hectare) and the lowest productivity of orange was observed in period-II (7.35 metric tonnes per hectare).

The instability in productivity of orange in India during studied period (1993-94 to 2012-13), the highest instability was observed in period-III (16.14%), followed by period-II (15.18%) and the lowest instability was observed in period-I (12.43%). In the semi log trend, during the study period 1993-94 to 2012-13, the highest compound growth rate observed in period-I (3.05%), followed by period-II (0.64%) and the lowest compound growth rate was observed in period-III (0.60%) (Table 3).

Conclusion:

Growth and instability in area of orange in India was the highest instability observed in overall period-III (13.09 %) and lowest instability was observed in period-II (11.02%). Area of orange in India for period-II and period-III was positive and significant at 1 per cent level. Growth and instability in production of orange in India was the highest instability observed in period-II (28.14%) and lowest instability was observed in period-I (13.75%).

Production of orange in India for period-II, period-II and period-III was positive and significant at 5 per cent level. Growth and instability in productivity of orange in India was the highest instability observed in overall period-III (16.14%) and lowest instability was observed in period-I (12.43%). During the study period observed that area, production and productivity of orange had some fluctuations in time series data. In order to improve the growth scenario of orange crops, to boost the area under the cultivation of crops and productivity through adopting modern technology is a pre-condition in Indian horticulture sector, to overcome this phenomenon. On the policy side, as the issues of environmental degradation, sinking of arable land and urbanization have been at the forefront of national debate now, more emphasis should be given to enhance the yield level with the help of innovations and technology. Secondly, to enhance production and meet ever increasing demand of horticulture crops, cultivable waste lands of the bigger states could be brought under horticulture cultivation.

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