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Research Paper

Analysis of Growth Trends of Isabgolin Rajasthan - An Overview

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ABSTRACT

The growth trends in area, production and productivity of isabgol in Nagaur district and in the Rajasthan state as a whole have been estimated by the three growth rate functions/models like linear, semi-log and compound models. The estimates of growth rates pertained to the period from 2009-10 to 2018-19. In this analysis, semi-log growth function was found to bebest fitted model as it is having highest value of R^2 (coefficient of determination) and lowest value of RMSE (root mean square error). Findings showed that growth trends in area, production and productivity of isabgol in Nagaur district were significantly increased at a semi-log growth rate of 6.18, 10.34 and 6.31 per cent per annum during the study period, respectively. In Rajasthan state as a whole for the period 2009-10 to 2018-19, growth rates in area, production and productivity of isabgol were found significantly positive at the rate of 9.55 per cent per annum in area, 15.85 per cent per annum ain production and 6.18 per cent per annum in productivity, respectively. The result of the study indicated that the increase in production was attributed to the area and productivity of isabgol crop in Nagaur as well as Rajasthan state. It may be recommended that there is a need to increase the productivity of the crop mainly by developing improved varieties of isabgol suiting to the changing agro climatic condition of the state.

HIGHLIGHTS

- Growth rates in area, production and productivity were found positive and were maximum for production at Nagaur district.
- Growth rates in area, production and productivity were found significantly positive and were maximum for production in Rajasthan State.

Keywords: Growth trends, Isabgol, Rajasthan, RSME

The key medicinal and aromatic plants grown in India are aleo vera, ashwagandha, chakori, kalongi, mehandi, opium, dilseed, safedmusli, tulsi, coriander, mint, lemongrass, croma/ajwain, isabgol, sunflower, garlic, ginger etc. Among these, isabgolis one of the important medicinal and commercial crops in India. It is believed to have originated in Persia (Netali *et al.* 1990) which was introduced in India and found to be grown largely in India, West Asia, Pakistan, Bangladesh, Persia, Mexico and Mediterranean regions.

India is one of the leading countries in the world with respect to area, production and export of different medicinal and aromatic plants. In India, total area under medicinal and aromatic plants was 717 thousand hectares with the production of 889 thousand metric tonnes during the year 2018-19 (Annual report, Agriculture welfare, Ministry of Agriculture, India. agricoop.nic.in). The total export value of medicinal and aromatic plants was

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₹ 200.89 thousand lakhs in the year 2019-20 in India (Directorate General of Foreign Trade, Ministry of Commerce & Industry, GOI, 2019-20). In the Rajasthan state, area under medicinal and aromatic plants was 388 thousand hectares with production of 371thousand metric tonnes with productivity of 955 kg per hectare in the year 2018-19 (Handbook on Horticulture Statistics, Horticulture Division, Ministry of Agriculture, GOI, 2018-19).

India ranks first in Isabgol production and the sole supplier of seeds and husk in the International market. In India, area under isabgol cultivation was estimated at 448 thousand hectares with production of 432 thousand metric tonnes in the year 2018-19 (Indian Horticultural Database, National Horticulture Board, 2018-19). India is the largest exporter of Isabgol husk in the world. India exported Isabgol husk of ₹ 135366.34 lakhs during the year 2019-20 (Directorate general of foreign trade, Ministry of Commerce & Industry, GOI, 2019-20).

Major isabgol growing states in India are Western Rajasthan, Gujarat, Parts of Madhya Pradesh and Northern Belt and the Malwa tract. Rajasthan is one of the major isabgol producing state in India. In Rajasthan, total area under Isabgol was 333.95 thousand hectares with production of 170.67 thousand metric tonnes and productivity of 511 kg per hectare during the year 2019-20 (*Rajasthan Agriculture Statistics at a glance, 2020-21, Department of Horticulture*). Isabgol is mainly cultivated in Barmer, Jalore, Nagaur, Jaisalmer, Jodhpur, Bikaner districts in the state of Rajasthan. Nagaur district occupies second position in production and third position in area of isabgol (*Rajasthan Agriculture Statistics at a glance, Commissionerate of Agriculture, Rajasthan, Jaipur, 2020-21*). In Nagaur district, total area under Isabgol was 43.13 thousand hectares with production of 30.72 thousand metric tonnes and productivity of 712 kg per hectare during the year 2019-20 (*Rajasthan Agriculture Statistics at a glance, Commissionerate of Agriculture, Rajasthan, Jaipur, 2020-21*). The seeds and husks of Isabgol also contain different bases for medicinal values. Therefore, isabgol has been becoming a very important source of income for the farmers in country but, cultivation of Isabgol was practiced/found in some districts of Rajasthan due to varied agro-climate regions. So, there is a need for knowing the growth trends in area, production and productivity of isabgol crop in the particular district as well as in the state of Rajasthan.

MATERIALS AND METHODS

Rajasthan state has first rank in production of Isabgol in the country. Nagaur district occupies second position in terms of production of isabgol and third position in area put under isabgol cultivation and also lagging behind with research studies on such crop. Therefore, this study has been confined to Nagaur district and Rajasthan state. The secondary data on area, production and productivity of isabgol for Nagaur district as well as for Rajasthan state were collected from Directorate of Agriculture and Directorate of Economics and Statistics, Government of Rajasthan, Jaipur for a period of 2008-09 to 2017-18.

The growth trends in area, production and productivity of isabgol crop were worked out through using following the three growth rate functions which were used by Deka and Sarmah 2005.

1. Simple linear function

$$Y_t = a + bt$$

Initially, the simple linear function has been applied to estimate the growth rate assuming that the time series data follows the linear trend.

2. Semi-log function

$$\log Y_t = a + bt$$

The semi-log function has been applied to estimate the growth rate for getting more reliable results as compared to simple linear function. The transformation has been applied in the output variable because it has the nature of volatility over time.

3. Compound growth rate function

$$Y_t = a\,(1+r)^t$$

The Compound growth rate function has been applied to estimate the growth rate for getting

more reliable results as compared to the semi-log function. It is assumed that the model has given approximately the same results as the semi-log result due to the same nature of transformation in the output variable. However, the value of the growth rate has produced an improved result.

Where,

Y_t = Time series data on area/production/productivity of isabgol crop 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.

After fitting the first linear trend function by least-square method, the estimate of *b* is denoted by $\hat{b}$. Then, annual linear growth rate was computed as follows:

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

Where,

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

Second, semi log function was fitted by least square method and estimate of *b* as $\hat{b}$ was obtained. The annual growth rate was then computed as:

$$r = \hat{b} \times 100$$

To obtain annual compound growth rate, the third function was first linearized by taking natural log on both sides, *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 was computed as:

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

The best fitted function was judged on the basis of the high value of R^2 (coefficient of determination) and low value of RMSE (root mean square error), which was expressed in percentage. Among the growth model functions, best-fitted model was used for the explanation of the analysis of growth rate. In case, the data having high level of fluctuation, the standard transformation techniques on data of area, production and productivity was used. For the best fitting of above models, the time series data on area, production and productivity of isabgol are smoothed by three years moving-average method. In case of Rajasthan state and Nagaur district, time series data on area, production, productivity were smoothed by this moving-average method.

RESULTS AND DISCUSSION

Growth trends in area, production and productivity of isabgol in Nagaur district

Table -1 shows growth trends in area, production and productivity of isabgol during the period 2009-10 to 2018-19 in Nagaur district and indicated that growth in area under the isabgol cultivation increased at a semi-log growth rate of 6.18 per cent per annum which was significant at 5 per cent level of probability. Production of the isabgol was significantly increased at semi-log growth rate of 10.34 per cent per annum. The positive growth trend in productivity of isabgol was registered at 6.31 per cent per annum and it was found significant at 5 per cent level during the study period i.e. 2009-10 to 2018-19. The coefficient of determination (R^2) was estimated to be 0.56, 0.41 and 0.34 indicated that 56 per cent, 41 per cent and 34 per cent of variation in area, production and productivity, respectively. The results revealed that the increase in production of isabgol was due to the increase in area and productivity of the crop in the Nagaur district. Similar results were observed by Mishra (2003), Boyal *et al.* (2015) and Boyal and Mehra (2016).

Growth trends in area, production and productivity of isabgol in Rajasthan state

This table 2 depicts growth trends in area, production and productivity of isabgol in Rajasthan state as a whole for the period 2009-10 to 2018-19. Study revealed that isabgol area registered a significant growth trend of 9.55 per cent per annum at 1

Table 1: Growth trends in area, production and productivity of isabgol during 2009-10 to 2018-19 in Nagaur district

Sl. No.	Growth model	Response variable	Coefficients		Growth-rate (% per annum)	R^2 (coefficient of determination)	RMSE	F value
			β_0 (Intercept)	β_1 (X Variable)				
1	Linear	Area	30492.6*	2601.98*	6.16	0.62	5379.43	9.82*
	Semi-log	(3MA)	10.35*	0.061*	6.18	0.56	0.1424	7.92*
	Compound		10.35*	0.061*	6.38	0.56	0.1424	7.92*
2	Linear	Production	15288.37+	3959.15+	11.95	0.48	10817.87	5.62+
	Semi-log	(3MA)	9.87+	0.10+	10.34	0.41	0.3266	4.21+
	Compound		9.87+	0.10+	10.90	0.41	0.3266	4.21+
3	Linear	Productivity	-109552*	54.78*	6.96	0.39	159.59	3.29*
	Semi-log	(3MA)	-120.59*	0.063*	6.31	0.34	0.2082	2.57*
	Compound		-52.37*	0.027*	6.52	0.34	0.0904	2.57*

*Figures in parentheses are level of significant; ** Indicating significant at 1% level of significant; * Indicating significant at 5% level of significant; + Indicating significant at 10% level of significant; 3MA Indicating 3 years moving average.*

Table 2: Growth trends in area, production and productivity of isabgol during the period 2009-10 to 2018-19 in Rajasthan state

Sl. No.	Growth model	Response variable	Coefficients		Growth-rate (% per annum)	R2 (coefficient of determination)	RMSE	F value
			β_0 (Intercept)	β_1 (X Variable)				
1	Linear	Area	157472.9**	26708.9**	9.61	0.88	26024.35	44.23**
	Semi-log	(3MA)	12.07636**	0.09559**	9.55	0.86	0.09814	39.84**
	Compound		12.07636**	0.09559**	10.03	0.86	0.09814	39.84**
2	Linear	Production	35348.68**	30627.46**	17.68	0.72	49983.19	15.76**
	Semi-log	(3MA)	11.2510**	0.15859**	15.85	0.73	0.25011	16.88**
	Compound		11.2510**	0.15859**	17.18	0.73	0.25011	16.88**
3	Linear	Productivity	412.89+	42.3849+	7.02	0.47	118.502	5.37+
	Semi-log	(3MA)	6.09877+	0.06184+	6.18	0.44	0.36214	4.78+
	Compound		6.09877+	0.06184+	6.38	0.44	0.36214	4.78+

*Figures in parentheses are level of significant; ** Indicating significant at 1% level of significant; * Indicating significant at 5% level of significant; + Indicating significant at 10% level of significant; 3MA Indicating 3 years moving average.*

per cent level of significant. On the other hand, production increased significantly at the growth rate of 15.85 per cent per annum at 5 per cent level of significance. The positive growth rate of productivity for isabgol was registered at 6.18 per cent per annum which was significant at 10 per cent level of significance. Isabgol cultivation recorded a positive growth trends in area, production and productivity during the study period in the state as a whole. The coefficient of determination (R^2) was 0.86, 0.73 and 0.44 indicating that 86 per cent, 73 per cent and 44 per cent of variation in area, production and productivity, respectively, was due to time. The result of the study indicated that the increase in production was attributed to the area and productivity of isabgol crop in the Rajasthan state. Similar results were reported by Kumawat and Meena (2005), Acharya *et al.* (2012) and Rai *et al.* (2014).

CONCLUSION

It was concluded that the growth trends in area, production and productivity of isabgol in Nagaur district were significantly positive and increased at the rate of 6.18, 10.34 and 6.31 percent per annum, respectively and in the Rajasthan state, growth trends in area, production and productivity of isabgol in Nagaur district were significantly positive and increased at the rate of 9.55, 15.85 and 6.18 percent per annum, respectively during 2009-10 to

2018-19. There is a need to increase the productivity of the crop mainly by developing improved varieties of isabgol suiting to the changing agro climatic condition of the state.

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