

Comparative Analysis of Plant Growth Geometry of Ravi Crop (Cauliflower) using Leaf Area Index, Crop Growth Rate and Relative Growth Rate in Three River Basin Area of South Bengal.

Dr. Dipak Bisai¹

¹Assistant Professor, Department of Geography, Egra S.S.B.College., West Bengal, India,

Abstract- The name cauliflower consists of two Latin words, 'caulis' and 'floris', the former means cabbage and the later means flowers. Cauliflower curd is a very popular vegetable now days. This paper comprises the comparative analysis of cauliflower in three different river basin areas. The considered river basin areas are Damodar, Kansai and Rupnarayan. Among them, the adjacent six districts are selected and the twenty four samples collected from the closely adjacent blocks. Moreover, some common variety of cauliflower production are selected, these are Early Kunwari, Pusa Early synthetic, Pusa Deepali, Pant Gobhi-2, 4 respectively. To compare the production result, main three types of robust statistical methods were applied like Leaf Area Index (LAI), Crop Growth Rate (CGR) and Relative Growth Rate (RGR). The trial and reflective survey has been conducted since 2014 to 2017 on post monsoon and winter seasons for each considered years. The raw data is processed through above stated statistical methods and finally fed in Table-1, Table-2, and Table-3 and in Table-4. After these three calculations, it is reveal that, planting geometry (25cm × 25cm) is more effective for Pusa Deepali variety. Major portion among the traditional farmers of Damodar river basin have maintained this planting geometry and got more effective production of cauliflower curd during winter season. The climatic effect over these three basin area is almost same, so seasonal effect is more important for this cultivation. This crop is very sensitive to the deficiency of boron and molybdenum. However, the rich bench of magnesium, boron and molybdenum contain soil layer is favorable for this cultivation. According to this concept, Damodar river basin is more effective for cauliflower production.

Keywords –Leaf Area Index (LAI), Crop Growth Rate (CGR), Relative Growth rate (RGR), Planting geometry of cauliflower.

I. INTRODUCTION

. South Bengal area is the part of lower Gangetic basin of Indian sub-continent. This area is very fertile in quality. From the beginning of the Indian civilization, agriculture continues to be the backbone of the economy over this area. Southern part of the West Bengal lies in between this area. Agriculture remains the crucial sector of this state and around 72 percent of the total population lives in the rural area of the West Bengal and agricultural practice continues to be their main life supporting activities. Many rivers flow over the south Bengal area and simultaneously support their physical performance to remain the fertile soil and seasonal irrigation. The different agricultural demand has to be fulfilled by the yielding of different crops. Among them, the Ravi crops are more important over this area. This types of cultivation continues during the winter season basically. However, the farmers produce their local demand of vegetables using the natural help. The productivities of soil, slope of the basin, climatic behaves, irrigation facilities etc. are the overall frame structure for the cultivation of different Ravi crops. In this way each and every river basin area produces different variety and amount of Ravi production in different economic year. The heterogeneity across different regions as well as variation in different farms are influenced by the host of biophysical (e.g. climate, soil fertility, slope etc.) and /or socio economic (e.g. preferences, prices, production objectives etc.) factors [1]. Developing a typology constitutes an essential step in any realistic evaluation of the constraints and opportunities that exists within the farm households for forwarding appropriate policy inventions [2-4]. The factors that define farm typology vary from study to study or from region to region. These may be as diverse as agro ecological, socio-economic, managerial, infrastructural and broader issues of livelihoods [5]. Open field vegetable cultivation is also controlled by the above stated factors. According to these view an attempt is made to identify the variation characters of cauliflower production in three different river basin areas of West Bengal and analyze comparatively, which will help the farming community over the all agro-climatic zones of the state.

II. MATERIALS AND METHODS

2.1 Data network and survey procedure-

The geographical area of this study has been selected along with three river basin area like Kansai basin, Rupnarayan basin and Damodar basin respectively. As per guidelines of the Indian Agricultural Statistical Research Institute, Pusa, New Delhi, West Bengal has six agro-climatic zones and this study area comprises with these old alluvial zone and lateritic red soil zone. Kansai and Rupnarayan River flows over the old alluvial zone and major part of the Damodar River contributes its influence over the lateritic red soil zone. Twenty four blocks were selected from six districts such as Bardhaman, Bankura, Hooghly, Paschim Medinipur, Purba Medinipur and Howrah respectively and consecutive four years data were collected since 2014 to 2017. These blocks are adjacent to the selected three major river basins. Each four representative cultivated area were selected randomly and the area comprised of small-marginal, medium and large in holding size taken up for this survey and 25 days interval data were collected. Different types of Rabi crops being cultivated on this region but the growth and production of cauliflower is selected because it is the most commercial one for economic benefits. The general varieties of the cauliflower that has been cultivated over this area is given in Table: 1. Cauliflower has a wide range in adaptation to distinct climatic conditions, prevailing over temperate subtropics region as well as tropical parts. So it is the wide spread cultivation over different regions. The optimum temperature for growth of young plants is around 23 °C, but in later stages 17-20 °C are most favorable. The cultivators of this region have selected sowing time in first fortnight of August for Kunwari variety and first week of September for Pusa Deepali variety respectively. During this period the average temperature prevail near about 24 °C to 27 °C.

Table: 1: Varieties of cauliflowers cultivated by this region.

Maturity	Varieties	Temperature requirement for curd intimation and development
Early	Early Kunwari	20 °C -27 °C
September, Maturity	Pusa Early synthetic	20 °C -25 °C
October, Maturity	Pusa Deepali	20 °C -22 °C
Mid-Oct. to Mid-Nov. maturity	Pant Gobhi-2,4	20 °C -23 °C
Mid-Nov. to Mid-Dec. maturity	Pusa Hybrid-2, 3.	17 °C -20 °C
Mid-Dec to Mid-Jan. maturity	Pusa Himjoti	12 °C -17 °C

2.2. Statistical Methods-

Plant observation such as functional leaves/sample land area, number of split zone/m², dry weight of plant/sample land area, LAI, CGR, RGR were recorded at 25, 50 and 75 day interval and at harvest. To calculate LAI (Leaf area index) CGR (Crop growth rate), RGR (Relative growth rate) by the following formula:

$$\text{Leaf Area Index} = (\text{Total Leaf Area/Unit of Land Area}) \quad (1)$$

$$\text{Relative Growth Rate} = (\ln W_2 - \ln W_1) / (t_2 - t_1) \quad (2)$$

Where, \ln = Natural log, W_1 = Dry weight of plant/m² recorded at time t_1

W_2 = dry weight of plant/m² recorded at time t_2 and unit expressed as g/g/day.

$$\text{Crop Growth Rate} = \{W_2 - W_1 / P (t_2 - t_1)\} \quad (3)$$

Where, P = Ground Area, W_1 = Dry weight of plant/m² recorded at time t_1

W_2 = dry weight of plant/m² recorded at time t_2 and unit expressed as g/m²/day.

III. RESULT AND DISCUSSION.

The Leaf Area Index (LAI) is mainly noticed the photosynthetic area of any plant. This paper reveals the variation of leaf area growth, crop growth rate and relative growth rate of Cauliflower are selected for three river basin area mainly Damodar basin, kansai basin and Ruonarayan river basin area respectively. Cauliflower is the short living plant, so that the time duration or phase detection has selected every 25 days after from the beginning of the sowing time. According to this view three phases has selected as phase-I (25 days), phase-II (50days) and phase-III (75 days) accordingly. The result of the leaf area index is given in Table-2. The selection of site or planting geometry is one of the important factors for cauliflower cultivation. For the betterment of the development of cauliflower leads due to scientific management of sowing. Practically the untrained farmers manage their land for their better economic benefit only. However, three types of planting geometry were found in different three river basin areas. The consecutive four years data has reflected from three selected sites. It has shown that, 25cm × 25cm planting geometry is better for all the considered years. The mean value of this planting geometry is also high than the rest two geometrical arrangement. This result has also reflected for every selected phases. The farmers of the Damodar

basin area are mainly maintaining 25cm × 25cm planting geometrical manner, so that their production of curds of cauliflowers are large in shape. Now a day's Pusa Deepali variety is very common and popular among the cultivators and huge number of farmers of Damodar basin area using this variety for more production of full shaped curd in short period of time.

Table-2: Results of LAI in order to different plant geometries and varieties used at different intervals during Cauliflower cultivation.

Site	Leaf Area Index (LAI)														
	25 Days (Phase-I)					50 Days (Phase-II)					75 Days (Phase-II)				
	2014	2015	2016	2017	Mean	2014	2015	2016	2017	Mean	2014	2015	2016	2017	Mean
Planting Geometry															
20 × 20cm	7.2	8.2	8.4	7.4	7.3	10.2	9.8	12.8	12.0	11.2	14.5	14.5	15.1	14.6	14.6
25 × 25cm	8.7	7.9	8.2	8.7	8.3	10.3	10.4	11.7	13.8	11.5	16.8	17.8	17.6	17.4	17.4
30 × 30cm	6.8	8.4	7.8	8.1	7.7	11.4	11.5	13.4	14.5	12.7	14.8	16.4	13.8	16.3	15.3
Variety															
V-I	6.5	6.3	6.1	7.0	6.4	7.1	8.6	7.9	7.3	7.7	10.3	11.5	13.2	12.8	11.9
V-II	7.2	7.1	8.1	7.5	7.4	7.9	9.5	8.5	9.5	8.8	11.7	12.3	11.0	14.5	12.3
V-III	7.1	7.5	6.8	6.3	6.9	6.5	8.1	7.2	7.1	7.2	10.5	10.4	11.4	12.6	11.2

V-I: Kunwari, V-II: Pusa Deepali, V-III: Pant Gobhi-2.

Crop growth rate and relative growth rate are also the important character for crop production analysis. This paper also reveals the result of both these characters. According to the same plant geometry as well as same variety used by the farmers which are stated earlier gets significant results on production. These results are given in Table-3 and Table-4. The phase-II growth rate is always higher than the other phase of growth period.

It's a common phenomenon for every Rabi or green vegetable production while the planting geometry follows scientific manner. In case of the cauliflower cultivation, the phase-III is only developing stage. After the compose of the given Table-3 it is found that, 25 cm × 25 cm planting geometry is more important for curd development of cauliflower. If we look over the result table, the mean values are always high for every phase sub-section. The overall development and crop growth rate exhibits remarkably high for the Pusa Deepali variety. Relative growth rate also measured for this plant and the result is given in Table-4. In this case, the 25 cm × 25cm planting geometry and Pusa Deepali variety are incredible for all the three selected basin area.

Table-3: Results of Crop Growth Rate (CGR) in order to different planting geometries and varieties at different intervals during Cauliflower cultivation.

Site	Crop Growth Rate (CGR g/m ² /day)														
	25 Days (Phase-I)					50 Days (Phase-II)					75 Days (Phase-II)				
	2014	2015	2016	2017	Mean	2014	2015	2016	2017	Mean	2014	2015	2016	2017	Mean
Planting Geometry															
20 × 20cm	10.2	12.0	11.3	12.8	11.57	24.5	21.4	23.4	23.4	23.17	46.1	41.5	42.1	41.0	42.67
25 × 25cm	11.2	14.2	12.5	14.5	13.1	26.3	26.3	25.1	26.4	26.02	52.1	51.3	45.8	46.3	48.87
30 × 30cm	12.3	12.3	10.8	12.0	11.85	21.8	21.5	22.1	21.5	21.72	43.1	46.1	41.3	41.5	43
Variety															
V-I	9.5	8.5	7.5	8.5	8.5	17.5	18.2	16.5	19.5	17.9	55.4	55.4	51.2	49.8	52.9
V-II	10.1	9.5	9.6	10.5	9.9	20.4	21.5	21.7	18.4	21.2	62.4	51.7	54.7	51.8	55.1
V-III	9.2	7.5	8.4	9.4	8.6	18.4	19.6	19.8	16.7	18.6	58.4	53.1	52.8	48.3	53.1

V-I: Kunwari, V-II: Pusa Deepali, V-III: Pant Gobhi-2.

Table-4: Results of Relative Growth Rate (RGR) in order to different planting geometries and varieties at different intervals during Cauliflower cultivation.

Site	Relative growth rate (RGR g/g/day)														
	25 Days (Phase-I)					50 Days (Phase-II)					75 Days (Phase-II)				
	2014	2015	2016	2017	Mean	2014	2015	2016	2017	Mean	2014	2015	2016	2017	Mean
Planting Geometry															
20 × 20cm	0.10	0.60	0.78	0.21	0.4	1.54	1.58	1.68	1.14	1.4	0.88	0.15	0.58	0.48	0.5
25 × 25cm	0.20	0.48	0.94	0.15	0.4	1.36	1.10	1.47	1.38	1.3	0.36	0.01	1.58	1.58	0.8
30 × 30cm	0.13	0.28	0.55	0.36	0.3	1.95	3.24	1.69	1.56	2.1	0.14	0.24	0.31	0.65	0.3
Variety															
V-I	0.12	0.21	0.34	0.84	0.3	0.87	0.15	0.55	0.58	0.3	0.22	0.31	0.54	0.25	0.3
V-II	0.32	0.54	0.36	0.66	0.4	0.95	0.99	0.84	1.20	0.9	0.89	0.47	0.87	0.95	0.7
V-III	0.55	0.21	0.15	0.41	0.3	0.66	1.25	1.36	0.97	1.06	0.45	0.54	0.65	0.44	0.5

V-I: Kunwari, V-II: Pusa Deepali, V-III: Pant Gobhi-2.

IV. CONCLUSION

Cauliflower is one of the popular vegetable over the tropical community. So the farmers can produce this vegetable randomly under favorable physical and economical situations. It can be grown in all types of soil with high fertility and good regime of climatic effect. Only the light soil these plants are very sensitive to drought and therefore sufficient moisture supply is important for the healthy development of cauliflower. For early production, farmer's preferred light soil but mid-session maturity they used loamy or clay-loamy field for better production. During the survey, which has been conducted through the last four years, it has been established that, cauliflower plant is more sensitive to deficiency of boron and molybdenum. Also the rich presence of magnesium helps more to this crop. Soil quality of Damodar basin area is more suitable for this crop and rich minerals layers are common support. So the production, growth, shape and size of curd are better than the rest two basin area.

V. REFERENCES

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