

Phenological Studies Of *Curcuma Caesia* Roxb. And *Curcuma Aromatica* Salisb. Of Zingiberaceae From Upper Brahmaputra Valley, Assam, India.

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Abstract: Phenology is the study of relationship between climatic factors and periodic events of the life cycle of living beings. Plant Phenological study provides all valuable information about the pattern of vegetative growth and development of plants. Thus, it provides valuable information for setting priorities for the conservation of threatened species by the means of domestication and cultivation. In order to study the phenological details of two important Zingiberaceae medicinal plants viz. *Curcuma caesia* Roxb. and *C. aromatica* Salisb. a field experiment was laid out at the Botanical garden of J.B. College (Autonomous), Jorhat, Assam. by maintaining the collected plant materials i.e. rhizomes of both the species from different areas of Upper Brahmaputra Valley (UBV) zone of Assam. Initiation of shoot from rhizome, leaf measurement, inflorescence development, no of flowers, flowering period, longevity of flowers, fruit formation etc were recorded for both the plants. Plant height, leaf number etc were recorded from 60, 100, 140 and 180 days after planting.

Index Terms: Zingiberaceae, Phenology, Upper Brahmaputra Valley (UBV) Zone, Jorhat.

1. INTRODUCTION

Phenology is the study of periodic phenomena in organisms and how these are influenced by seasonal and interannual variations in climate, as well as habitat factors. The study of phenological aspects of plants involves the observation, recording and interpretation of the timing of their life history events [1]. The study of plant phenology provides knowledge about the pattern of plant growth and development as well as the effects of environment and selective pressures on flowering and fruiting behaviour [2]. The knowledge of timing of phenological events and their variability can provide valuable data for planning, organizing and timely execution of certain standard and special agricultural activities that require advanced information on the dates of specific stages of crop development [3]. Plant Phenological study provides all valuable information about the pattern of vegetative growth and development of plants. Zingiberaceae, is a Monocotyledonous family of yielding spices, condiments, dyes, perfumes and medicines besides many ornamental species cultivated for their showy flowers [4]. Zingiberaceae is well known for its immense medicinal values and is widely distributed throughout the tropics, particularly in Southeast Asia. The most important genera coming under Zingiberaceae are *Curcuma*, *Kaempferia*, *Hedychium*, *Amomum*, *Zingiber*, *Alpinia*, *Elettaria* and *Costu* [5]. Plants of genus *Curcuma* belongs to Zingiberaceae family is known for their high therapeutic potentials. *Curcuma caesia* and *Curcuma aromatica* are two widely used high valued but threatened medicinal plants found in wild state in Assam.

Traditionally the rhizomes of *Curcuma caesia* Roxb are used in treating leprosy, asthma, cancer, epilepsy, fever, wound, vomiting, menstrual disorder leucoderma, , piles, bronchitis, rheumatic pains etc. *C. aromatica* is used for dysentery, curing indigestion, gastric ailments, rheumatism, indigestion, healing wounds and fractured bones and to prevent helminthes infections by the the different ethnic communities of Upper Brahmaputra Valley (UBV) Zone of Assam. *Curcuma caesia* is a critically endangered and *C. aromatica* is a threatened species as per the IUCN Red List of threatened species. Human activities like, habitat destruction, deforestation, unscientific and unsystematic collection for traditional medicine purposes, industrialization, urbanization etc. exerts a pressure over these plant species and they gradually becomes threatened. Therefore, setting priorities for the conservation of these important medicinal plants of north east India is a need of hour. Domestication and cultivation of these species may serve as one of the most important strategy for the conservation of these species. Knowledge of reproductive phenology is the key to achieving their conservation through agriculture.

2. METHODOLOGY

2.1 About the Study Site

Assam is situated in North-East India. Assam can be broadly divided into the Six Agro-climatic regions. The Upper Brahmaputra Valley (South) zone comprises the Districts of Tinsukia, Dibrugarh, Sibsagar, Jorhat, Golaghat and newly formed district Charaideo and Majuli covering an area of 16,013 sq.km accounting for 20.40 percent of total area of Assam and is extended between 26.45° and 27.15° N latitudes and 94.25° and 95.25° E longitudes. It has elevation of 86.6 Mtrs. The average annual rainfall is 1920 mm and temperature vary between 15°-37°C. Soil is alluvial and suitable for cultivation. Semi evergreen-deciduous forest and grassland are the dominating vegetation type of the study site. In Upper Brahmaputra Valley (UBV) Zone of Assam, July is the warmest month of the year with averages temperature of 29 °C and January is the coldest month, with temperatures averaging 15 °C during 2017-18.

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Humidity was 90% and annual average rainfall was about 1900mm.

2.2 Methods of the study

For phenological study the fresh rhizome of *Curcuma caesia* Roxb. and *Curcuma aromatica* Salisb were collected from three districts of Upper Brahmaputa Valley of Assam, India viz. Sivasagar, Jorhat and Golaghat. The plant material was identified and authenticated in the department of Botany, J.B. College (Autonomous), Jorhat, Assam, India. A field experiment was laid out by maintaining the collected plant materials i.e. rhizomes at the Botanical garden of J.B. College (Autonomous), Jorhat, Assam having soil P^h - 5.2. Initiation of shoot from rhizome, Leaf measurement, Inflorescence development, no of flowers, Flowering period, Longevity of flowers, Fruit formation etc were recorded for both the plants. Plant height, leaf number etc were recorded from 60, 100,140 and 180 days after planting. Rhizomes were planted during 1st week of April, 2017. The study was conducted for two consecutive year 2017 and 2018.

2.3 Soil Analysis

To evaluate the nutrients availability and fertility status of soil of the field soil analysis were carried out. Representative soil samples were collected by adopting procedures described by Cline MG [6] and Acharya SM [7] and were preserved in sealed polythene bags for further analysis. Soil organic carbon was determined by Walkley-Black chromic acid wet oxidation method [8]. Available nitrogen was determined adopting Kjeldahl digestion and distillation method described by Verma et al., [9]. Phosphorus was determined by Bray's method [10] and Potassium was determined by adopting method of Jackson [11].

3. RESULT AND DISCUSSION

Curcuma caesia Roxb. Is a perennial rhizomatous herb. Rhizome externally brownish with bluish black colour inside. The plant height is about 84.5 cm after 180 days of plantation. Matured leaves are up to 17 x 45 cm in size, leaves are lanceolate or oblong oblong-elliptic or oblong-lanceolate. Inflorescence appears from the base of the rhizome, flowers are pale yellow in colour with reddish at outer border. Leaves generally appear after the flowers. Green foliage dies in late autumn and the rhizomes remain dormant in winter. *Curcuma aromatica* Salisb is a perennial leafy rhizomatous herb. The plant height is about 83 cm after 180 days after plantation. Rhizome orange yellow, creamy and aromatic. Matured leaves are up to 17 x 44 cm in size, leaves are oblong-elliptic or oblong-lanceolate. Inflorescence appears from the base of the rhizome, flowers are pinkish white. Leaves generally appear after the flowers. Green foliage dies in late autumn and the rhizomes remain dormant in winter. Phenology of aerial morphological characteristics is given in the Table-1, 2 and 3. Result of soil analysis is given in table- 4.

Table: 1- Plant height and height of petiole at four growth stages (average of 4-6 plants)

Species	Days after Plantation				Days after Plantation			
	60	100	140	180	60	100	140	180
	Plant height in cm				Petiole Height in cm			
<i>C. aromatica</i>	26.5	52	73	84.5	10	22	33	38
<i>C. caesia</i>	25.5	51	72.5	83	10	22	32	38

Table: 2- Size of leaf and leaf number of at four growth stages (average of 4-6 plants)

Species	Days after Plantation				Days after Plantation			
	60	100	140	180	60	100	140	180
	Size of leaf in cm				Leaf Number			
<i>C. aromatica</i>	L-15 B-7	L-29 B-11	L-38 B-15	L-45 B-17	1-2	6-8	8-9	8-9
<i>C. caesia</i>	L-14 B-7	L-28 B-11	L-39 B-14	L-44 B-17	1-3	5-8	7-9	7-10

L- Length, B- Breadth.

Table: 3 - Different phenological characteristics.

Sl. No	Parameters	<i>C. aromatica</i>	<i>C. caesia</i>
2	Inflorescence development	82-91 days (2 nd Year)	74-80 days (2 nd Year)
3	No of flowers	10-14	9-12
4	Flowering period	June - July	June-July
5	Longevity	1-2 days	1-2 days
6	Fruit formation	No	No

Table: 4 - Result of the Soil Analysis:

Sl No	Parameter	Tested Result
1	% Organic Carban	0.29
2	N (kg/ha)	112.98
3	P2O5 (kg/ha)	3.72
4	Sulphur (mg/kg)	7.69

4. CONCLUSION

It was observed that both the species exhibited almost uniformity in all the aerial growth characters. Average plant height *C. aromatica* after 180 days of plantation is 83 cm and *C. caesia* is 84.5 cm. No. of green leaf decreases gradually with increasing age. As per available data *Curcuma caesia* is a critically endangered and *C. aromatica* is a threatened species as per the IUCN Red List of threatened species. Plant Phenological study provides all valuable information about the pattern of vegetative growth

and development of plants which are helpful for setting priorities for the conservation of rare and endangered plant species. Therefore, phenological observation of these widely used ethnomedicinal but threatened plant species of North – East India is very much essential in order to conserve them by the means of domestication and cultivation.

5. CONFLICTS OF INTEREST

The authors declare that there are no conflicts of interest regarding the publication of this article.

6. ACKNOWLEDGEMENT

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References

- [1]. Fenner, M., The phenology of growth and reproduction in plants, Perspectives in Plant Ecology, Evolution and Systematics, 1998, Volume 1, Number 1, pp. 78-9, Urban & Fischer.
- [2]. Zhang, G., Song, Q., Yang, D., "Phenology of *Ficus acemose* in Xishuangbanna, Southwest China", 2006, Biotropica 38: 334-339.
- [3]. Ruml M and Vulic T., "Importance of phenological observations and Predictions in agriculture" , Journal of Agricultural Sciences , 2005, Vol. 50, No 2, 217-225.
- [4]. Borah, L.C., Sharma,G.C., Systematic survey of Zingiberaceae of Dibrugarh district, Assam, India, Indian Journal of Fundamental and Applied Life Sciences, Vol. 2 (2) April-June, 2012, pp.365-373.
- [5]. Joy, P. P., Thomas J., Mathew, S., and Skaria, B. P., Zingiberaceous Medicinal and Aromatic Plants. Aromatic and Medicinal Plants Research Station, Odakkali, Asamannoor P.O., Kerala, India, 1998.
- [6]. Cline, M. G. "Principles of soil sampling", Soil Science, 58(4), 275-288, 1944.
- [7]. Acharya SM, Collection and preparation of soil, water and plant samples for analysis, International Journal of Chemical Studies; 2018 6(2): 3298-3303
- [8]. Allison LE, "Organic Carbon," in: C. A. Black, Ed., Methods of Soil Analysis, Part 2, Chemical and Microbiological Properties, American Society of Agronomy, Madison, pp. 1367-1378, 1965.
- [9]. Varma K.K, Patel L.B, Toor G.S and Sharma P.K, Int. J. of Agriculture and Biology; 2, 295-297, 2005.
- [10]. Jackson M.L, Soil Chemical Analysis, (Prentice Hall, Inc. Eaglewood Cliffs, N.Y. , pp 219-221, 1962.
- [11]. Jackson M.L, Soil Chemical Analysis, Prentice Hall India Pvt.Ltd. New Delhi , p-498,1967.