International Journal of Agriculture Sciences
ISSN: 0975-3710 & E-ISSN: 0975-9107, Volume 13, Issue 2, 2021, pp.-10634-10637.
Available online at https://bioinfopublication.org/pages/jouarchive.php?id=BPJ0000217

Research Article

CULTIVATION PRACTICES OF *CURCUMA ANGUSTIFOLIA* ROXB.,IN ICAR RESEARCH COMPLEX FOR NEH REGION, MANIPUR CENTRE, LAMPHELPAT, IMPHAL, INDIA

SINGH S.S.[1]*, THOKCHOM R.[2], THOKCHOM J.[2], HARIPRIYA DEVI M.[3], DHABE A.S.[1] AND SINGH P.K.[4]

[1]Department of Botany, Dr Babasaheb Ambedkar Marathwada University, Aurangabad, 431004, Maharashtra, India
[2]Department of Horticulture, South Asian Institute of Rural and Agricultural Management (SAIRAM), Imphal, 795113, Manipur, India
[3]P.G.Department of Botany, Manipur College, Imphal, 795001, Manipur University, Imphal, 795003, Manipur, India
[4]Department of Life Sciences, Manipur University, Imphal, 795003, Manipur, India
*Corresponding Author: Email - estatecellmanipur@gmail.com

Received: February 01, 2021; Revised: February 25, 2021; Accepted: February 26, 2021; Published: February 28, 2021

Abstract: *Curcuma angustifolia* Roxb., which is under threatened category was cultivated under ICAR, Research Complex for NEH Region, Manipur Centre, Lamphelpat field condition. Experiments were planned with Factorial Randomized Block Design for3-crop seasons (2018 to 2020). The study encompasses the growth and development of *C. angustifolia*, seedlings, influenced by spacing, vermicomposting and correlations amongst the growth parameters, so as to validate the most favourable conservation method for this endangered plant. During the three crop seasons, the third crop (2020) is the best. Among the treatments, T5 (S2 V2) and T9 (S3 V3) were found to be the remarkable crop production and plant growth parameters. Spacing of 75-90 cm with compositing at 3-4 tons/ha) were the best. Whereas, lowest value of treatment T1 in which 60 cm spacing and 2 tons/ha compositing was found unfavourable. Strong positive correlation between leaf surface area and plant height on the growth and development was found to be effective among other correlations.

Keywords: *Curcuma angustifolia Roxb., Endangered, Growth and development, Correlation, Soil nutrient, Spacing and vermicomposting*

Citation: Singh S.S., *et al*., (2021) Cultivation Practices of *Curcuma Angustifolia* Roxb., in ICAR Research Complex for NEH Region, Manipur Centre, Lamphelpat, Imphal, India. International Journal of Agriculture Sciences, ISSN: 0975-3710 & E-ISSN: 0975-9107, Volume 13, Issue 2, pp.- 10634-10637.

Academic Editor / Reviewer: Dr Vipul N Kapadia

Introduction

Curcuma angustifolia Roxb.is a fast growing annual herb, generally distributed in the foothills, at an elevation of 915 to 1220 metres above the mean sea level in Manipur. It attains a height up to 90-180 cm. The genus Curcuma of the family Zingiberaceae comprises of about 80 species, widely distributed in tropic of Asia, Africa, Southeast Asia, Australia and other warm parts of the world [1].

C. angustifolia Roxb., commonly known as East Indian Arrowroot, is an important medicinal plant [2], having tremendous export value in national and international market. *C. angustifolia* is called by different names in India *i.e.* Tikhur in Hindi, Keturi Halodhi in Bengali, Tavakshira in Sanskrit, Yaipal in Manipuri, Tavakeera in Marathi, Koova in Malayalam, Ararut-kizhagu in Tamil, Koove-hittu in Kannada, Ararut-gaddalu in Telugu. It is a rhizomatous perennial flowering plant with modest and small spiked inflorescence and found throughout the Eastern India, Central and Southern India [3].

In India Yaipal is commonly used as a demulcent, nutritious, contains starch which is used for children due to easily digestible. It is an excellent diet in the form of conjee in case of dysentery, dysuria, gonorrhoea, etc. Yaipal is used in many ailments dates back close to 5000 years. Ayurveda codified about 8000 herbal remedies. Tavaksheeri is a drug used in many ailments for its various pharmacological activities. Tavaksheeri is the starch obtained from the rhizomes of *Curcuma angustifolia*. Dalhana identified that tugakshiri is something which is quite similar to vamsalochana & now identified as *Curcuma angustifolia*.

In Manipur State Yaipal is a common plant with high demand for its flower as well as rhizome. Flowers developed after monsoon *i.e*., during the month of March-April and continues up to May-June before the development of young shoots. People of Manipur indiscriminately harvested the flowers for the preparation of many delicacies (Bora, Eronba, Athongba, Kanghou, *etc*.) as a vegetable. The flowers are selling in the local market @ Rs.100 to 200 per kg in fresh or in dried condition. So, in Manipur, there is continuous exploitation, habitat-degradation, unsustainable harvesting and over-exploitation bringing substantial loss of the habitat of Yaipal is still going on. Keeping this in view, an experiment was designed to validate the most favourable cultivation practices by following the Agricultural practices of ICAR, Research Complex for NEH Region, Manipur Centre, Lamphelpat field condition.

Review of Literature

In India, tribal people consume it for healing various ailments such as jaundice, kidney disorders, thirst, fever and flattening the body [4]. Rhizomes are used in treating bone fractures, inflammation and intestinal disorders [5]. The rhizome part of this species is used to cure peptic ulcers, diarrhoea, colitis and also used in treatment of dysentery [6]. Leaf oil of *C. angustifolia* possessed antimicrobial activity [7] and the essential oil extracted from this species are used for its antibacterial and antifungal properties [8]. Both leaves and rhizome of *C. angustifolia* have a camphoraceous aroma and comprises diverse functional constituents such as phenolics, flavonoids and various antioxidant enzymes. The species is of substantial nutritional value particularly as a source of starch for medicine and Indian food. The starch or the powder derived from starch is highly nutritive and digestible and therefore suggested for weak children, infants and invalids. Starch of *C. angustifolia* used as Tugaksheeree is an important ingredient in many Ayurvedic medicines [9].

Yaipal rhizomes are used as an appetizer reducing burning sensations and stomach pains, removal of stone from kidney, useful for ulcer patient [10] and rhizome pulp is used for treatment of headache as well as it gives cooling effect [11]. The rhizome pulp is a remedy for fever, joint pains and leucorrhoea.

The starch of Yaipal is used for the preparation of many sweet meals and herbal dishes like halwa, barfi, jalebi, etc. It is used specially during fast (Vrata, Upwas). Farmers also prepare herbal drink "sarbat" through tikhur starch during summer due to its cooling effect [12].

Jena *et al* (2016) [13] extracted leaf essential oil of *C. angustifolia* and was found to be predominant with oxygenated sesquiterpenes (68.20 %). Because of the presence of remarkable phytoconstituents, the leaf essential oil of *C. angustifolia* would have enough significance in the food and pharmaceutical industries. Ghyar *et al* (2019) [14] carried out an experiment of *C. angustifolia* cultivation program based on the influence of spacing on yield, quality and economics of Tikhur. Closest spacing of T1- 45 cm × 20 cm produced highest rhizome yield per plot, rhizome yield per hectare and starch yield per hectare. Starch recovery per cent and protein content did not change due to different plant spacing. Spacing of T1 - 45 cm × 20 cm recorded maximum gross return and net return however maximum benefit: cost ratio was observed in spacing of T4 - 60 cm × 20 cm.

Ghyar *et al* (2020) [15] also conducted an experiment during 2018-2019 on the effect of spacing on growth and yield of Tikhur (*Curcuma angustifolia* Roxb). In respect of growth parameters closer plant spacing *i.e*. higher plant density produced maximum plant height and leaf area index. Whereas wider spacing produced maximum number of leaves per plant, leaf length and leaf breadth, while, lesser spacing produced the maximum yield per plot and yield per hectare.

Shankar *et al* (2014)[16] observed that, high heritability coupled with high genetic advance was for weight of secondary finger rhizome per plant, weight of mother rhizome per plant, etc. Shankar *et al* (2015)[17] did the assessment of genetic divergence of quantitative characters of 20 genotypes of Tikhur plant and concluded that genotypes IGBT10-4 and IGSJT-10-2 is recommended to be used as parents for starch recovery per cent and total rhizome yield.

Materials and Methods

Study site: The present work has been taken up to cultivate *Curcuma angustifolia* Roxb. plant, commonly known as Yaipal in Manipuri, which are under the Rare Endangered and Threatened (RET) category, so as to conserve the plant species by following modern tools of agricultural practices under ICAR, Lamphelpat, Imphal field condition. Plantation and Cultivation of Yaipal was done during 2018 to 2020 (3 seasons) in the study plots of ICAR Research Complex for NEH Region, Manipur Centre, Lamphelpat, Imphal [Fig-1].

Table-1 *Layout Plan for the Cultivation and Propagation of Curcuma angustifolia Roxb.*

Plot Size	4.0m x5.0m	Design	Factorial Randomized Block Design
Treatment	Factor 1		Spacing 3 levels: (S_1= 60 cm, S_2= 75 cm, S_3= 90 cm)
	Factor 2		Vermicomposting 3 levels: V_1= 2 ton/ha (600 gm/plant), V_2= 3 ton/ha (900 gm/plant), V_3= 4 ton/ha (1200 gm/plant)
Rows (R)			
R_1	R_2	R_3	Treatments
T_5	T_6	T_3	T_1= S_1V_1 (60 cm x 2 ton/ha (600 gm/plant)
T_3	T_4	T_5	T_2= S_1V_2 (60 cm x 3 ton/ha (900 gm/plant)
T_9	T_8	T_7	T_3= S_1V_3 (60 cm x 4 ton/ha (1200 gm/plant)
T_6	T_9	T_6	T_4= S_2V_1 (75 cm x 2 ton/ha (600 gm/plant)
T_1	T_1	T_1	T_5= S_2V_2 (75 cm x 3 ton/ha (900 gm/plant)
T_4	T_7	T_4	T_6= S_2V_3 (75 cm x 4 ton/ha (1200 gm/plant)
T_8	T_5	T_2	T_7= S_3V_1 (90 cm x 2 ton/ha (600 gm/plant)
T_2	T_3	T_9	T_8= S_3V_2 (90 cm x 3 ton/ha (900 gm/plant)
T_7	T_2	T_8	T_9= S_3V_3 (90 cm x 4 ton/ha (1200 gm/plant)

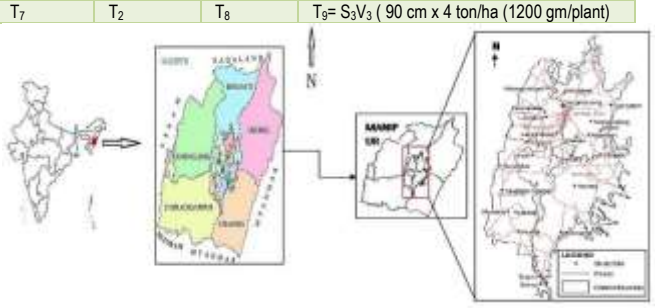

Fig-1 Study area: A. Map of India showing the location of Manipur; B. Map of Manipur showing districts; C. Map of Manipur showing the location of Imphal valley; D. Map of Imphal valley and study sites ICAR, Lamphelpat.

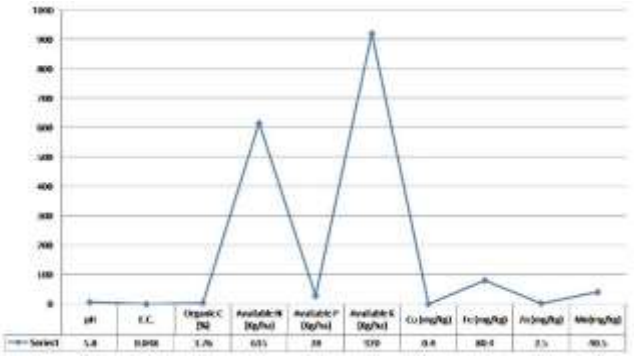

Fig-2 Soil analysis of the Experimental Fields of *Curcuma angustifolia* Roxb., Lamphelpat.

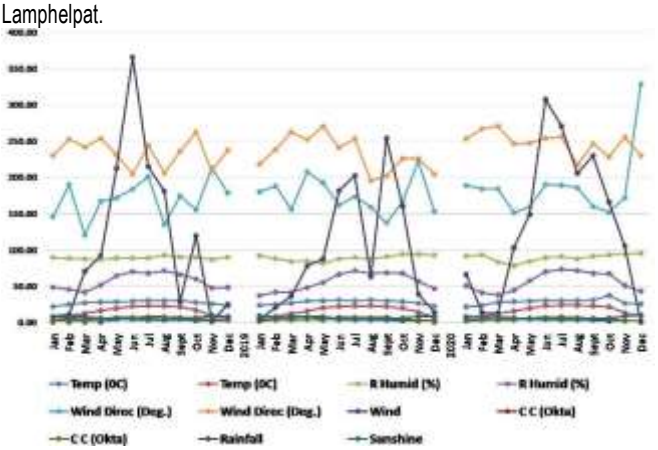

Fig-3 Weather data of *Curcuma angustifolia* Roxb. experimental farm at ICAR Research Complex, Lamphelpat, Imphal from 2018 to 2020.

Treatments: Two factors: Factor 1: Spacing 3 levels, (S1=60 cm, S2=75 cm, S3= 90 cm); Factor 2: Vermicomposting 3 levels (V1= 2 ton/ha (600 gm/plant), V2= 3 ton/ha (900 gm/plant), V3= 4 ton/ha (1200 gm/plant), Design: Factorial Randomized Block Design, Plot Size: 4.0 m x 5.0 m [Table-1].

Meteorological Data of the experimental farm was recorded from ICAR Complex during the tenure of the research program. Soil analysis of the experimental farms were analyzed at ICAR Research Complex for NEH Region, Manipur Centre, Lamphelpat, Imphal. Plant Leaf surface area was measured by using a Mobile-application technique called "Petiole: Plant Leaf Area Meter".

Results and Discussion

Plantation was done in the month of July, in 3 levels spacing and vermicomposting was done in 3 levels; flowering was recorded during the month of March to May of the next year and harvesting follows. Among the treatments, larger the spacing and more vermicomposting results best flower initiation and good rhizome weight. During the three crop seasons, the third crop (2020) is the best in all the parameters. Ghyar *et al* (2019)[14]carried out an experiment of *C. angustifolia* cultivation program and reported that, in net return however, maximum benefit: cost ratio was observed in spacing of T4- 60 cm × 20 cm. However, in the present Yaipal cultivation spacing of 75-90 cm with compositing at 3-4 tons/ha)in treatments T5 and T9 were the best. Whereas, lowest value of treatment T1 in which 60 cm spacing and 2 tons/ha compositing was unfavorable for the growth of Yaipal. The plant can grow luxuriantly in the ICAR Experimental Farm, Lamphelpat. However, among the treatments, T5 (S2 V2) and T9 (S3 V3) found the remarkable crop production and plant growth parameters [Table -2].

Soil samples of the experimental plots were analyzed at ICAR Research Complex for NEH Region, Manipur Centre, Lamphelpat, Imphal. Soil pH value was 4.7 *i.e.* acidic; E.C. was 0.040; organic carbon was 1.3 %; available N, P and K were found to be 405, 20 and 439 kg/ha respectively. Some micronutrients viz., Cu, Fe, Zn and Mn ranges from 2.0, 78.20, 1.2 and 32.80 mg/kg respectively [Fig-2]. Correlation between growth parameters were made on the growth and development of *C. angustifolia*. Strong positive correlation between leaf surface area and plant height was found to be effective among other correlations [Fig-4].

Table-2 *Influence of spacing and vermicomposting on growth and development of Curcuma angustifolia Roxb.*

Treatment	Plant height (cm)	No. of leaves/plant	No. of plants/ clump	Days to spike emergence	No. of inflorescenc e/clump	Length of flower	Weight of individual flower	No. of rhizomes/ clump	Weight of rhizome /clump (g)	Leaf area (cm^2)
Year (Y)										
Y_1 (2018)	52.139	10.622	14.044	278.752	11.163	18.519	19.651	21.744	366.091	680.283
Y_2 (2019)	57.091	10.719	14.548	277.37	10.689	19.118	20.338	22.193	378.924	645.641
Y_3 (2020)	55.277	11.363	14.526	273.696	11.2	18.217	20.733	23.496	389.816	655.596
S.E.(m)±	1.071	0.207	0.305	3.024	0.368	0.301	0.473	0.495	5.363	10.337
C.D. at 5%	3.046	NS*	NS	NS	NS	NS	NS	1.408	15.521	NS
Spacing (S)										
S_1 (60 cm)	55.444	11.674	12.185	282.022	11.526	14.166	14.415	18.052	311.341	376.652
S_2 (75 cm)	54.92	11.459	16.326	266.904	11.83	21.467	18.967	22.848	377.787	598.954
S_3 (90 cm)	54.143	9.57	14.607	280.893	9.696	20.221	27.34	26.533	445.703	1005.914
S.E.(m)±	1.071	0.287	0.305	3.024	0.368	0.301	0.473	0.495	5.363	10.337
C.D. at 5%	NS	0.815	0.867	8.598	1.046	0.855	1.345	1.408	15.251	29.394
Vermicomposting(V)										
V_1 (2 tons/ha)	51.885	10.326	13.733	284.311	10.326	17.345	17.261	19.604	333.003	543.301
V_2 (3 tons/ha)	56.314	10.933	14.956	274.396	12.015	19.323	20.875	22.43	380.145	662.864
V_3 (4 tons/ha)	56.309	11.444	14.43	271.111	10.711	19.185	22.586	25.4	421.683	775.356
S.E.(m)±	1.071	0.287	0.305	3.024	0.368	0.301	0.473	0.495	5.363	10.337
C.D. at 5%	3.046	0.815	0.867	8.598	1.046	0.855	1.345	1.408	15.251	29.394
Interaction (SXV)										
T_1= S_1V_1	49.469	10.089	10.956	291.333	10.044	11.542	12.107	14.889	276.361	322.696
T_2= S_1 V_2	55.332	11.311	12.378	285.067	12.8	13.642	15.496	17.022	298.081	385.982
T_3= S_1 V_3	61.53	13.622	13.222	269.667	11.733	17.313	15.642	22.244	359.58	421.279
T_4= S_2 V_1	53.219	10.867	15.356	277.533	11.133	20.089	16.229	20.1	333.533	485.604
T_5= S_2V_2	54.974	11.8	17.889	256.822	12.867	23.307	19.582	23.511	393.704	593.827
T_6= S_2V_3	56.568	11.711	15.733	266.356	11.489	21.004	21.091	24.933	406.123	717.432
T_7= S_3V_1	52.968	10.022	14.889	284.067	9.8	20.404	23.449	23.822	389.114	821.602
T_8= S_3V_2	58.634	9.689	14.6	281.3	10.378	21.02	27.547	26.756	448.65	1008.783
T_9= S_3V_3	50.828	9	14.333	277.311	8.911	19.238	31.023	29.022	499.344	1187.356
S.E.(m)±	1.856	0.496	0.528	5.237	0.637	0.521	0.819	0.857	9.29	17.905
C.D. at 5%	5.277	1.412	1.501	NS	NS	1.48	NS	NS	26.415	50.912
C.V.	10.152	13.661	11.021	5.68	17.348	8.389	12.143	11.444	7.367	8.132

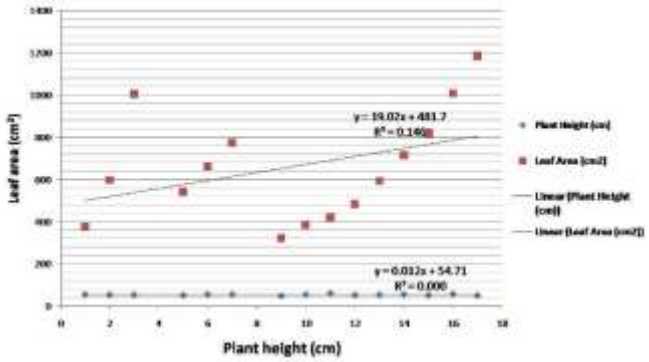

Fig-4 Correlation between leaf surface area and plant heighton the growth and development of *Curcuma angustifolia* Roxb.

Conclusion

Indian arrowroot (*Curcuma angustifolia* Roxb.) commonly known as Yaipal in Manipuri belongs to the family Zinziberaceae, is a RET medicinal plant, naturally available in Manipur State, North Eastern India. Continuous exploitation, habitat degradation, unsustainable harvesting and over-exploitation bring substantial loss of their habitat. Scientific cultivation of Indian arrowroot was done at ICAR Research Complex for NEH Region, Manipur Centre, Lamphelpat, Imphal. QPMs (Quality Planting Materials) were adopted in the present research program. Plant Growth Analysis and good harvesting techniques were also adopted to conserve the plant and the findings should be reached to the farmers. Indian arrowroot should be planted at a spacing of 75-90 cm during the month of July, vermicomposting at 3-4 tons/ha, flowering during March to May and harvesting of rhizomes followed. Soil samples for the cultivation of Indian arrowroot should be maintained as follows: Soil pH value was 4.7 *i.e.* acidic; E.C. was 0.040; organic carbon was 1.3 %; available N, P and K were found to be 405, 20 and 439 kg/ha respectively. Some micronutrients viz., Cu, Fe, Zn and Mn ranges from 2.0, 78.20, 1.2 and 32.80 mg/kg respectively [Fig-2]. Weather data of the experimental farm shows that high rainfall noticed during the months of July and September every year; during the plantation months *i.e.* July temperature is highest and during winter (November to February) the plant dried up and harvesting follows during April-May *i.e.* spring season [Fig-3].

Application of research: Plant Growth Analysis and good harvesting techniques for the endangered medicinal plant and findings should be reached to the farmers

Research Category: Farm mechanization

Abbreviations: ICAR-Indian Council of Agricultural Research, NEH-North Eastern Hill, RET- Rare Endangered and Threatened, QPMs-Quality Planting Materials

Acknowledgement / Funding: Authors are thankful to Department of Botany, Dr. Babasaheb Ambedkar Marathwada University, Aurangabad, 431004, Maharashtra, India and Joint Director, ICAR Research Complex for NEH Region, Manipur Centre, Lamphelpat, Imphal for research facilities and valuable suggestions.

****Research Guide or Chairperson of research: Dr Arvind S. Dhabe**
University: Dr. Babasaheb Ambedkar Marathwada University, Aurangabad, 431004, Maharashtra, India
Research project name or number: PhD Thesis

Author Contributions: All authors equally contributed

Author statement: All authors read, reviewed, agreed and approved the final manuscript. Note-All authors agreed that- Written informed consent was obtained from all participants prior to publish / enrolment

Study area / Sample Collection: Manipur Centre, Lamphelpat, Imphal, India

Cultivar / Variety / Breed name: *Curcuma Angustifolia* Roxb

Conflict of Interest: None declared

Ethical approval: This article does not contain any studies with human participants or animals performed by any of the authors.
Ethical Committee Approval Number: Nil

References

[1] Sasikumar B. (2005) *Plant Genet. Resour.*, 3, 230-251.
[2] Srivastava A.K., Srivastava S.K. & Syamsundar K.V. (2006) *Flavour Frag. J.*, 21, 423- 426.
[3] Sharma A. (2012) *Indian J. Tradit. Knowl.*, 11, 154-155.
[4] Rao S.M. & Rao R. (1914) *Flowering plants of Travancore, Vol. XIV. Government Press, Trivendrum (Reprinted by BSMP, Dehra Dun)*, 400.

[5] Jain S.K. (1995) *Ethnobotany*, 7, 83-88.
[6] Patel S., Tiwari S., Pisalkar P.S., Mishra N.K., Naik R.K. & Khokhar D. (2015) *Indian J. Nat. Prod.Resour*., 6, 213-220.
[7] Shukla A.C., Pandey K.P., Mishra R.K., Dikshit A. & Shukla N. (2011) *J. Nat. Prod*., 4, 42-50.
[8] Doble B., Dwivedi S., Dubey K. & Joshi H. (2011) Int. J. Drug Discovery Herbal Res., 1, 46-49.
[9] Rajashekhara N. & Sharma P.P. (2010) *Ayu*., 31, 482-486.
[10] Sharma R.(2003) *Medicinal plants of India- An Encyclopedia. Daya Publishing House, Delhi. pp* 75.
[11] Nag J. L., Shukla, N., Pararey, P. M., Soni, V. K., Netam, C. R. &Pandey, D. K. (2006) *National Seminar on Medicinal, Aromatic & Spices Plants Perspective and Potential. IGKV, TCB, CARS, Bilaspur, Chhattisgarh. pp*185.
[12] Singh R. & Palta A. (2004) *Tribal Health Bulletin. Regional Medical Research Centre for Tribles (ICMR), Nagpur Road, Jabalpur (M.P.).* 10 (1&2), 33-40.
[13] Jena S., Ray A., Sahoo A., Kar B., Panda P.C. and Nayak S. (2016) *TEOP*, 19 (6), 1527-1531.
[14] Ghyar M.P., Sonkamble A.M. & Patil S.R. (2019) *Journal of Pharmacognosy and Phytochemistry*, 8(4), 3489-3491.
[15] Ghyar M.P., Sonkamble A.M. &Tayade V.D. (2020) *Multilogic in Science*, 9 (32), 318-319.
[16] Shankar D., Rao S., Singh J. & Mukherjee S. C. (2014) *Plant Archives*, 14 (2), 655-663.
[17] Shankar D., Rao S.S., Singh D.P., Markam P.S. & Sahu M.K. (2015) *Plant Archives*, 15 (2), 743-751.