Effect of different altitudinal zones on growth parameters of *Garcinia indica* (Choisy) in Uttara Kannada

Abstract

*Garcinia indica*is an economically important tree species known worldwide for its excellent anti-obesity property. Field study was conducted to determine the effect of altitudes on growth parameters of *G. indica* in four different altitudinal zones of Uttara Kannada. Significant influence of site conditions and altitude on the growth parameters of *G. indica* such as tree height, girth at breast height and crown diameterwere observed. Zone-B (536-550 m MSL) showed highest mean tree height of 10.73 m. Whereas, Zone-C(431-461 m MSL) recorded maximum mean crown diameter of 7.08 m. Zone-D shows Highest mean of girth at breast height was 69.67 cm showed significant variation between the Zones. Higher tree growth was found in Zone-B and Zone-C region for growth parameters like total height and crown diameter. Least growth was found in Zone-A (603-670 m MSL).

Keywords:*Garcinia indica,*altitudinal zones variation in growth parameters

Introduction

The genus Garcinia, which belongs to the Cluciaceae family, has about 200 species that are found throughout the world's tropics, mostly in Asia, Africa and Polynesia(Roberts, 1984).*Garcinia indica* is a tropical evergreen, slender tree with sloping branches, it reaches heights of 15 m. The mature kokum fruit is either dark purple or crimson with a yellow tint. It has 3-8 big seeds embedded in a red acid pulp in a regular pattern, similar to orange segments, in a white pulpy substance (Krishnamurthy, 1984). The tree is mostly found along the Konkan region of Maharashtra's Ratnagiri district, Goa, in Karnataka's district of Uttara Kannada, Udupi, Dakshina Kannada. It is known by various names across India including Murugalu in Kannada, Tallow tree in English and in Malayalam it is called Punarpuli(Swami *et al*., 2014).

The rind and seeds of the *Garcinia indica* fruit have a wide range of uses, including culinary, cuisine, fruit drinks, medicines and industrial. It's also known as an Indian spice with a nice flavour and a sweet acidic (sour) taste, making it a favourite culinary addition. In several Indian recipes, it is historically used as an acidulant. This tree is gaining popularity as

its fruits have a wide range of applications, from pharmaceuticals to high-quality drinks. Dysentery, tumours, cardiac problems, stomach acidity and liver ailments have all been claimed to be treated with kokum. Garcinol, hydroxy citric acid and anthocyanin pigment are three significant chemical elements found in fruit rind. Garcinol is a fat-soluble yellow pigment that contains hydroxy citric acid, an acidulant and physiologically active chemical that has been demonstrated to help people lose weight (Krishnamurthy *et al.*, 1982).

Garcinia is an evergreen, tall growing tree found in the West coast of India, it flourishes well in coastal part at a hight of 10 to 16 m, having girth of 50 to 100 cm with conical shaped greenish crown. The tree is grows will in high rain fall with medium altitude zones (Rema and Krishnamurthy, 2000).A full-grown *G. indica* tree attains a height of about 16 to 20 meters. The tree itself is ornamental with a dense canopy having lush green leaves with red tinged tender emerging leaves. Being a pyramid shaped handsome evergreen tree, it is a good choice for growing along the roads and railway tracts (Braganza *et al*., 2012).*Garcinia* species are generally small or medium sized evergreen treesare distributed in pantropical regions, with high species richness in South-East Asia. *Garcinia indica* is evergreen to semi-evergreen tree up to 15 m hight, exudation milky, branches with conical crown or pendulous drooping, the tree grows very good in ghat areas as compare to plain areas(Shameer *et al*., 2016).

Material and methods

The present study was carried out in Uttara Kannada district in Karnataka, a part of Central Western Ghats. The rainfall in these sites ranges between 2545 to 4722 mm per year and the altitude ranges between 52.4 to 670.4 m (Table 1).The four different altitudinal zones based on different levels of altitudes were chosen and classified as Zone-A (603-670 m MSL), Zone-B (536-550 m MSL), Zone-C (431-436 m MSL) and Zone-D (52-77 m MSL). In each zone, two sites were randomly selected, in each site five trees were selected as replications. Trees of 60-75 cm girth class were selected based on GBH. The experiment was laid out using randomized complete block design. Growth parameters like total tree height (m), girth at breast height (cm)and crown diameter (m) were measured.

Results and discussion

The present study was taken up in study area the influence of altitudinal zones on *Garcinia indica* growth parameter of tree height, girth and crown diameter of *Garcinia indica* in Uttara Kannada district.

Growth parameters of *Garcinia indicaviz.* mean girth at 1.37 m from base of tree (cm), mean total tree height (m) and mean crown diameter (m) are presented in Table 2.The growth parameters such as total tree height, girth at breast height and crown diameter showed statistical significant difference between Zones, tree and also interaction. Among the sites the tree height varied from 9.17 to 12.05 m, highest tree height was observed in site (S_2) of Zone-B and lowest was in site (S_1) of Zone-D. Among the altitudinal zones higher tree height was observed in medium altitudinal Zone-B and Zone-C. lower tree height was observed in lower altitudinal Zone-D with 10.32 mrepresented in Table 2.

The tree girth at breast height was varied from 61.60 to 70.80 cm, maximum girth was found in site (S_2) of Zone-D and minimum was in site (S_1) of Zone-B. It indicated among the altitudinal zones maximum tree girth was observed in Zone-C and Zone-D. lowest tree girthwas observed in high and medium altitudinal Zone-A with 65.43 cm and Zone-B with 63.97 cm(Table 2).

Among the sites the tree crown diameter varied from 6.02 to 7.23 m, widest tree crown diameter was observed in site (S_2) of Zone-C and narrowest was in site-1 (S_1) of Zone-D. Among the altitudinal zones widest tree crown diameter was observed in low altitudinal Zone-Cwith 7.08 m and Zone-B with 6.67 m. narrowest tree crown diameter was observed in high altitudinal Zone-A with 6.49 m represented in Table 2.

Higher tree height was found in Zone-A and Zone-B, however higher tree girth was found in Zone-C and Zone-D. Highest mean crown diameter was found in Zone-C and Zone-B. This may be due to moderate relative humidity, maximum rainfall and moderate light incident in the higher altitudinal region compared to lower altitudinal region. The location of the site had an effect on typical weather because of the latitude, elevation or proximity to weather modifying capabilities together with mountains or huge bodies of water and lush evergreen forests with rich organic nutrients in the soil, which helps in the better growth.

In present study, it was observed that growth parameters were vary with altitudinal zones and sites similar observation was made by Vitasse*et al.* (2009), they observed that the growth of tree varies along with climate and altitudinal gradient.

In present study, height of *Garcinia indica* was ranges from 9.17-12.05 m., similar results were reported by Singh, (1993), that *G. indica* is a slow-growing slender, tropical evergreen tree which grows to a height of 10-18 m naturally spread in Western Ghats and also in North-Eastern states. Shameer *et al.* (2016), reports that *G. indica* is evergreen to semi-evergreen tree grows up to the height of 15 m.

The present variation in tree growth parameter may be due to the capacity of a selected site to offer adequate nutrients for a tree relies upon on several elements and the proscribing component for tree growth might also additionally vary (Blyth, 1974). According to Turner (2001), trees are heavily depending upon sites and soils to offer water, nutrients, aeration and stability.

Table 1. Geographical and climatic information of study area in Uttara Kannada district, Karnataka

Altitudinal Zone	Site	Altitude (m)	Mean annual rainfall (mm)	Annual rainy days	Mean annual temperature (°C)
Zone-A	S_1	603.6	2545 - 3456	97	30.5
	S_2	670.4	2578 - 3269	97	30.9
Zone-B	S_1	550.3	2784 – 3568	110	28.9
	S_2	536.4	2756 – 3645	110	26.0
Zone-C	S_1	431.6	2986 – 3865	100	27.0
	S_2	436.3	3157 – 3945	100	25.0
Zone-D	S_1	52.4	3800 – 4722	120	25.6
	S_2	77.8	3800 - 4722	120	24.9

Table 2. Effect of altitudinal Zone and site variation on growth parameters

Altitudinal Zone	Site	Total tree height (m)	Girth at breast height (cm)	Crown diameter (m)
Zone-A	**S_1**	10.79	66.40	6.24

	S_2	10.34	64.47	6.74
	Mean	**10.57[b]**	**65.43[c]**	**6.49[c]**
Zone-B	**S_1**	9.41	61.60	6.18
	S_2	12.05	66.33	7.17
	Mean	**10.73[a]**	**63.97[d]**	**6.67[b]**
Zone-C	**S_1**	10.70	68.07	6.94
	S_2	10.41	68.53	7.23
	Mean	**10.56[b]**	**68.30[b]**	**7.08[a]**
Zone-D	**S_1**	9.17	68.53	6.02
	S_2	11.47	70.80	7.07
	Mean	**10.32[c]**	**69.67[a]**	**6.54[b]**
SEm ±	**Zone**	**0.031**	**0.260**	**0.071**
	Site	**0.035**	**0.290**	**0.080**
	Interaction	**0.070**	**0.518**	**0.160**
CD @ 5%	**Zone**	**0.088**	**0.731**	**0.204**
	Site	**0.099**	**0.818**	**0.228**
	Interaction	**0.198**	**1.635**	**0.456**

* a indicated that significantly maximumvalue
b indicated that second highest value
c indicated that third highest value
d indicate that lowest value

Conclusion

There was significant influence of site conditions on the growth parameters of *Garcinia indica* such as tree height, crown diameter and girth. Highest mean tree height was observed in Zone-B (10.73 m). Whereas, maximum girth (69.67 cm) in Zone-D andwidest mean crown diameter was recorded in Zone-C (7.08 m).Height,Girth and crown diameter showed significant variation between the Zones higher growth is found in Zone-A and Zone-B region for growth parameters like total height and bole height. From this observation we can conclude that there is some noticeable effect of different altitude (in taken altitudinal range) zones on the growth of *G. indica* trees in Uttara Kannada region.

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