Plant Archives Vol. 24, Special Issue (GABELS), 2024 pp.401-406 e-ISSN:2581-6063 (online), ISSN:0972-5210

Plant Archives

Journal homepage: http://www.plantarchives.org
DOI Url : https://doi.org/10.51470/PLANTARCHIVES.2024.v24.SP-GABELS.058

ASSESSMENT OF SURVIVAL AND GROWTH PERFORMANCE OF TREE SPECIES IN EARLY AGE URBAN PLANTATION OF KUMTA TOWN IN UTTARA KANNADA DISTRICT OF KARNATAKA INDIA

Ramesh Rathod[1*], Syed Ali [2], Murugesh Hatti [3] and Venkatesh L.[1]
[1]Department of Silviculture and Agroforestry, College of Forestry, Sirsi,
University of Agricultural Sciences, Dharwad- 580 005 Karnataka, India.
[2]Department of Silviculture and Agroforestry, College of Forestry, Sirsi, Karnataka, India.
[3]College of Forestry, Sirsi, University of Agricultural Sciences, Dharwad- 580 005 Karnataka, India.
*Corresponding author E-mail: rameshsr@uasd.in

ABSTRACT

Urban forests are vital for creating sustainable, resilient cities that enhance environmental health, human well-being, and the overall quality of urban life. They play a critical role in managing urban ecosystems by improving air quality, stabilizing soil, and fostering sustainability. However, urban forestry faces numerous challenges such as tree maintenance, survival, establishment, soil compaction, public support, inventory of planting sites, and high costs. To address these challenges, a study was conducted to assess the survival and growth performance of tree species in a one-year-old urban plantation in Kumta town, Uttara Kannada district, Karnataka. The results revealed varying survival rates among the planted species, ranging from 36.58% to 100%. Similarly, height growth increment rates varied from 4.5 % to 13.12 %, while girth increment rates ranged from 25.19 % to 42.08 %. Species such as *Swietenia macrophylla, Parkia speciosa*, and *Tamarindus indica* demonstrated 100% survival rates, with *Swietenia macrophylla* exhibiting the highest growth increment rates in both height and girth, followed by Parkia speciosa. Therefore, *Swietenia macrophylla* appears to be highly suitable for the region. However, species like *Tamarindus indica* and *Vateria indica* are not recommended for this region due to their slow growth rates,. This study underscores the importance of selecting appropriate tree species for urban plantations to ensure their survival and growth in urban environments for building greener and sustainable cities.

Keywords **:** Urban Forest, survivability, growth performance and sustainable cities

Introduction

Urban forestry is generally defined as the art, science and technology of managing trees and forest resources in and around urban community ecosystems for the physiological, sociological, economic and aesthetic benefits that trees provide to society. Urban forestry is practice by municipal and commercial arborists, municipal and utility foresters, environment policymakers, city planners, consultants, educators, researchers and community activists in several types of planting sites including street lawn, tree pit, avenue and cluster planting. These sites may require special considerations when selecting a species and choosing a proper planting technique. There are variety of places to plant seedlings or trees such as residential and business yards, parking lots, empty lots, highway medians, avenues, parks and courtyards between buildings.

Global climate change has been a focus for many years, in many countries in many fields. The increasing CO_2 concentration in atmosphere was considered as one of the main driving forces for global warming. Atmospheric CO_2 levels have risen from 280 ppm to 398.29 ppm from pre-industrial to the present (NOAA, 2015). Mitigation of climate change demands, determined commitment of scientists to develop

strategies to effectively manage the issues of changing climate through carbon sequestration. Two-thirds of terrestrial carbon is sequestrated in the standing forests. The air is being continuously polluted in urban areas through heavy traffic, industry, domestic fuel combustion, stone quarries, coal mines and various agricultural from adjoining areas. These particulates are no doubt dangerous to human health and environment causing various diseases to plants and animals, damage to properties including our cultural heritage, national monuments, archives etc. Dust concentration varies from place to place and hour to hour, diurnally depending upon traffic, type of industry etc. The highest dust concentration tends to be in summer, reaching maximum during mid-day and late-afternoon.

Today, 45 per cent of all human beings live in urban areas by the year of 2025; this figure will increase to 65 per cent. So, urban forestry is most important programme to bring sociological, ecological and economic benefits to the people. Cities occupy 3percent of the global terrestrial surface, but account for 78 percent of carbon emission, 60 percent of residential water use and 76 percent of wood used for industrial purposes. So, for the urban people canopy cover in the cities is very essential factor. Urbanization is a global phenomenon, although the degree of urbanization and the rate of urban growth vary in different parts of the world. People move towards cities not only for employment but also for education of their children and due to increase in annual income. This uncontrolled urbanization resulted in deterioration of natural resources and environment in urban areas in many of the cities in India as well as in the world. In India since primeval period, flowers and plants have been admired and cultivated. There are many references to the urban areas or urban forests in old Sanskrit and Buddhist literature. However, the splendid garden traditions were introduced to India by various Muslim conquerors from Persia, north and central Asia. Some of the Mughal gardens are still found in Delhi, Agra, Allahabad and Srinagar. After independence, in newly developed cities like Chandigarh, special care has been taken to include urban forestry in the city's planning. Most of the Indian cities, with the exceptions of Gandhinagar and Chandigarh, are far behind per capita urban forest availability in comparison to other cities in the world. Per capita urban green space is found to be highest in Netherlands followed by Gandhinagar in India and least is for Jaipur in India. New Delhi, the capital city of India has 20 percent of its geographical area is under green cover (Chaudhary and Tewari, 2011).

The urban forest is in a constant state of flux as people continuously plant trees, push them aside, build within natural woodlands and fashion the forests to their needs. The practice of urban forestry is an attempt to manage these activities in such a way as to make trees and related organisms, structures and people as compatible as possible. Urban areas are a challenging environment for trees. In particular, poor site conditions caused by insufficient rooting space, soil compaction, use of unsuitable soils, construction works, and utility trenching, and lack of tree care create unhealthy conditions for tree life in towns and cities.

Depending on the requirement of the planting site and site conditions appropriate species need to be selected. For example, trees suitable for urban avenues may not be suitable for parking areas. The choice of species should camouflage with the type of habitation, building patterns, colour of the countryside, nature of terrain and its texture. The relationship between location and stress has been central issue of many studies (Nils-son *et al*., 2000), street trees are exposed to a relatively high stress level and because of their exposure to multiple stresses their average life span is short. Park trees are exposed to moderate stress and compared to street trees park trees lifespan is relatively high. Successful urban forestry depends on the plants functioning as intended, even under stressful environments. Thus, the selection and use of suitable tree species and genotypes are important factors in a strategy aimed at improving quality and decreasing costs in the establishment and management of urban green areas. The effect caused by the choice of species and designs of plantings will contribute to a city's distinct aesthetic expression. So, for successful urban forestry programs, it is necessary to study survival, growth performance and adaptability of the tree species. Therefore, this study was carried out to assess the survival per cent of different tree species and the initial growth performance in one year old urban plantation of Kumta town.

Material and Methods

The experiment was conducted near Horticulture department in Kumta city. The area is of 2.5 hectare and Forest survey number- 440 /A. Soil is lateritic soil with more rocky area having soil pH 6.5 and Soil EC is about 0.001 dS /m. The plantation was made by Forest department in June 2018-20219 under 'Greening Urban Area scheme' launched by Government of India. The area has 1050 tree individuals and the area is covered by lateritic soil with hard rocky surface. The area is not

suitable for agriculture because poor soil depth, soil fertility and nutrient status, therefore the site is suited for tree species instead of crop species. The plantation included 9 different species trees with spacing 7.5 m × 7.5 m. The present field experiment was carried out during 2019-20 in the one-year-old plantation.

Details of treatments (Tree species planted)

The following nine treatments (different tree species were planted in the experimental area).

Table 1. Treatment details

Treatment details	
T_1	*Mangifera indica*
T_2	*Artocarpus heterophyllus*
T_3	*Syzygium cumini*
T_4	*Lagerstroemia speciosa*
T_5	*Vateria indica*
T_6	*Swietenia macrophylla*
T_7	*Parkia speciosa*
T_8	*Michelia champaca*
T_9	*Tamarindus indica*

Observations such as number of seedlings planted for each species, number of seedlings of each species survived were recorded. The growth parameters such as plant height, girth at collar, number of branches, plant per cent and increment were recorded initially at one year old plantation and at the end of second year.

Plant per cent and Increment percent was calculated by using this formula:

$$\text{Plant per cent (\%)} = \frac{\text{Number of plants survived}}{\textit{Total number of plant planted}} \times 100$$

Observation interval: Initial and final readings were recorded to determine increment per cent.

$$\text{Height Inrement per cent (\%)} = \frac{\text{Final height of tree} - \text{Initial height of tree}}{\text{Final height of tree}} \times 100$$

$$\text{Girth Inrement per cent (\%)} = \frac{\text{Final girth of tree} - \text{Initial girth of tree}}{\text{Final girth of tree}} \times 100$$

Results and Discussion

In the study area among nine different tree species *Tamarindus indica, Mangifera indica, Artocarpus heterophyllus, Syzygium cumini, Lagerstroemia speciosa, Vateria indica, Swietenia macrophylla* and *Michelia champaca* are indigenous species and *Parkia speciosa* is exotic (native to Indonesia, Malaysia and Thailand).

The study revealed that survival rates of planted species vary from 36.58 to 100 per cent. Species like *Swietenia macrophylla*, *Parkia speciosa*, and *Tamarindus indica* exhibit a 100 % survival rate. Other tree species also show promising survival rates, with *Syzygium cumini* at 99.41 %, *Mangifera indica* at 99.27 %, *Artocarpus heterophyllus* at 98.34 %, and *Lagerstroemia speciosa* at 97.64 % (refer to Fig. 1). The notable survival rates of *Swietenia macrophylla* may stem from its adaptability to coastal climates. Similarly, 100 % survival of *Parkia speciosa* could be attributed to its compatibility with the site conditions, resembling those of its native regions like Malaysia, Indonesia, and Thailand. On the other hand, *Michelia champaca* exhibits the lowest survival rate of 36.58 per cent, followed by *Vateria indica* at 57.95 %. This may be due to poor soil quality, characterized by deficiencies in nutrients, compaction, or improper drainage, might hindered root development and nutrient uptake, compromising the overall health and survival of tree species and inability of species to survive in such conditions (Table 2).

Table 2: Assessment of survival per cent of different tree species planted in Urban plantation of Kumta town.

Sl. No.	Name of the species	No. of individuals planted	No. of individuals survived	Survival (%)
1	*Mangifera indica*	137	136	99.27
2	*Artocarpus heterophyllus*	181	178	98.34
3	*Syzygium cumini*	172	171	99.41
4	*Lagerstroemia speciosa*	170	166	97.64
5	*Vateria indica*	88	51	57.95
6	*Swietenia macrophylla*	195	195	100
7	*Parkia speciosa*	31	31	100
8	*Michelia champaca*	41	15	36.58
9	*Tamarindus indica*	44	44	100

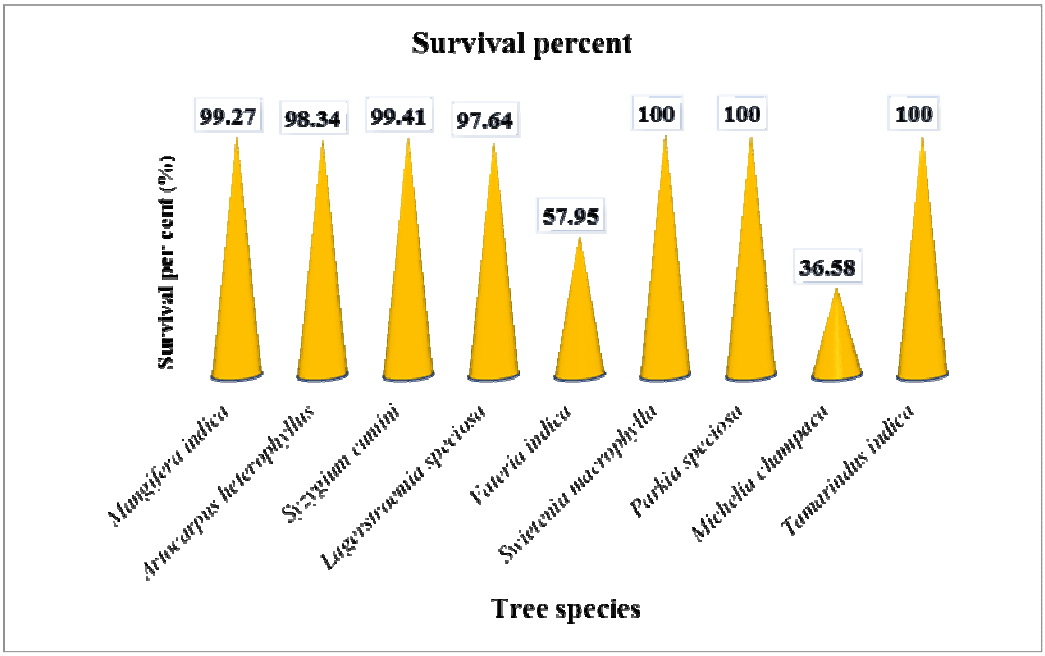

Fig. 1 : Survival per cent of different tree species planted in Urban plantation of Kumta town

Table 3: Assessment of height increment of different tree species planted in Urban plantation of Kumta town.

Sl. No.	Name of the species	Initial height (cm)	Final height (cm)	Increment (%)
1	*Mangifera indica*	180	200	10.00
2	*Artocarpus heterophyllus*	240.5	268.5	10.43
3	*Syzygium cumini*	210	228	7.89
4	*Lagerstroemia speciosa*	236	263	10.27
5	*Vateria indica*	233	245	4.90
6	*Swietenia macrophylla*	245	282	13.12
7	*Parkia speciosa*	240	270	11.11
8	*Michelia champaca*	163	178	8.43
9	*Tamarindus indica*	191	200	4.50

Table 4: Assessment of girth increment of different tree species planted in Urban plantation of Kumta town.

Sl. No.	Name of the species	Initial girth (cm)	Final girth (cm)	Increment (%)
1	*Mangifera indica*	7.80	12.00	35.00
2	*Artocarpus heterophyllus*	6.10	10.00	39.00
3	*Syzygium cumini*	6.30	10.30	38.83
4	*Lagerstroemia speciosa*	6.70	10.15	33.99
5	*Vateria indica*	7.70	10.60	27.36
6	*Swietenia macrophylla*	10.60	18.30	42.08
7	*Parkia speciosa*	11.62	19.40	40.10
8	*Michelia champaca*	6.35	10.20	37.75
9	*Tamarindus indica*	5.05	6.75	25.19

Growth rate vary significantly among different tree species and is influenced by various factors such as environmental conditions, soil quality, availability of water and nutrients, genetic characteristics, and competition. Fast-growing tree species exhibit rapid growth rates, often reaching maturity in a relatively short time span. In the present study the height growth increment rates ranged from 4.5 % to 13.12 %. All nine species exhibited favorable height growth responses under the prevailing climatic conditions. *Swietenia*

macrophylla demonstrated the highest increment rate at 13.12 %, followed by *Parkia speciosa* at 11.11 %, while *Tamarindus indica* showed the lowest increment of 4.50 %. Other species such as *Artocarpus heterophyllus* (10.43 %), *Mangifera indica* (10.00 %), *Michelia champaca* (8.43 %), and *Lagerstroemia speciosa* (10.27 %) and *Syzygium cumini* (7.89 %), displayed moderate growth rates. *Tamarindus indica* had the lowest height growth rate of 4.50 %, followed by *Vateria indica* at 4.90 % (Table 3).

Girth, a significant growth parameter in plants, reflects their overall growth performance. Girth increment rates ranged from 25.19 per cent to 42.08 per cent. *Swietenia macrophylla* exhibited the highest girth increment rate at 42.08 %, followed by *Parkia speciosa* at 40.10 %. Moderate girth increments were observed in *Artocarpus heterophyllus* (39.00 %), *Syzygium cumini* (38.83 %), *Michelia champaca (37.75), Mangifera indica* (35.00 %), and *Lagerstroemia speciosa* (33.99 %). *Tamarindus indica* showed the lowest girth increment rate at 25.19 %, followed by *Vateria indica* at 27.36 % (Table 4). The growth of tree species is significantly influenced by soil factors; areas with optimal soil depth and moisture content exhibited good tree growth. Conversely, areas with shallow soil depth experienced poor tree growth, likely due to limited moisture and nutrient availability for seedling roots. Similar results were reported by Hassan *et al.* (2007), who reported that *Cinnamomum iners* had highest survival rate followed by *Azadirachta excelsa* and the lowest in *Shorea leprosula*. *Azadirachta excelsa* exhibited the highest growth increment followed by *Shorea leprosula* and lowest in *Intsia palembanica* and stated that this indicates that indigenous species can be adopted to rehabilitate the degraded forest land. Sonti *et al* (2022) envisaged that matching native tree species to soil types represents a strategic approach to urban forest restoration, maximizing the ecological and socioeconomic benefits of green infrastructure projects while minimizing environmental risks.

Conclusion

Swietenia macrophylla, *Parkia speciosa*, and *Tamarindus indica* all exhibited cent per cent survival rates. However, when considering growth metrics such as height and girth increment, *Swietenia macrophylla* displayed the highest rates, followed closely by *Parkia speciosa*. Consequently, *Swietenia macrophylla* emerges as the preferred choice over *Parkia speciosa* due to its exotic nature and the relatively limited public awareness regarding its utility, as well as its lower economic value compared to *Swietenia macrophylla*. On the other hand, *Tamarindus indica* exhibited a slower growth rate, resulting in reduced carbon sequestration capacity and a longer time frame required to realize economic benefits. This underscores the potential of adopting indigenous fast-growing tree species for the restoration of degraded land in this region. By prioritizing species with robust growth characteristics, restoration efforts can be optimized for both ecological and economic outcomes for building sustainable cities.

Reference

Ampoorter, E., Hermy, M. and Verheyen, K. (2011). Effects of soil compaction on growth and survival of Tree saplings- a meta analysis. *Basic and Applied Ecology.,* 12(5): 394-402

Andrew, S.M. and Maliondo, M.S. (2002), Growth performance of *Azadirachta indica* provenances in Morogoro, Tanzania. *Journal of Tropical forest science*., 328-335.

Abdul, A., Tanaka, S., Jusop, S., Majid, N., Ibrahim, Z. and Siakurai, K. (2008). Rehabilitation of degraded tropical rainforest in Peninsular Malaysia with a multistoried plantation technique of indigenous *Dipterocarp* species, *Jpn. Journal For. Environment*, 50(2): 141 -152.

Chacko, K.C., Sankar, S., Chandrashekhar Pillai, P.K. and Pandailai, R.C. (2001). Establishment of greenbelt around Cochin refineries limited Ambalamugal. KFRI Research Report., No. 217, ISSN 0970-8103.

Onkar, C.K. (2006). Choice of eco-friendly trees in urban environment to mitigate airborne particulate pollution. *J. Hum. Ecol*., 20(2): 135-138.

Hassan, A., Razak, W. and Azani, M. (2007). Growth performance of nine years old selected indigenous wood species planted on degraded forest land. *Research journal of forestry.,* 3(1): 23-28.

Hariprasath, C.N., Balasubramanian, A. Prasanthrajan and Radhakrishnan, S. (2016). Performance evaluation of different tree species for carbon sequestration under wasteland condition. *International Journal of Forest Crop Improvement*., pp.7-13.

Mutanal, S.M., Patil, S.J. and Shahapurmath, G. (2007). Studies on mixed cropping of tree species with *Tamarindus Indica*. *Karnataka Journal Agricultural Sciences*, 20(3), 568-570.

Majid, N.M., Ibrahim, F.H., Manan, M., Yusoff, M.K., Azani, M. and Zaki, M.H. (1998). Rehabilitation of degraded forest land, *UPM Research Report*. pp. 298-307.

Majid, N.M. (1997). Rehabilitation of degraded and abandoned forestland, underutilized sandy soils and landfillsites. *Forestry Sciences*, 7(1): 113-127.

Sonti, N.F., Pregitzer, C.C. and Hallett, R.A. (2022). Native tree seedling growth and physiology responds to variable soil conditions of urban natural areas. *Restoration Ecology*, *30*(8):13653.

Thomas, B.R. and Benedikz, T. (2003). Selection of trees for urban forestry in the nordic countries. *Journal of urban forestry and urban greening*. pp. 101-114.

Thomas, B.R., Monique, B. and Stephen, P. (2002). Tree establishment practice in towns and cities-results from a European survey. *Journal of urban forestry and urban greening*., 1: 83-96.