Assessment of Growth performance of *Casuarina equisetifolia*clones in tropical region ofJabalpur District of Madhya Pradesh

ABSTRACT –An experiment was laid out at Tropical Forest Research Institute, Jabalpur (M.P.) India, to assess growth performance of *Casuarina equsetifolia* clones namelyIFGTB CH-1, IFGTB CH-2, IFGTB CH-3, IFGTB CH-4, IFGTB CH-5, IFGTB CH-6, IFGTB CH-7, IFGTB CH-9, IFGTB CH-10.The results revealed that the clone IFGTB CH-5 produced the maximum volume per m^3 followed by the Clone IFGTB CH-2 and IFGTB CH-4 because of the highest survival percentage among the all clones and maximum carbon stock was found in clone IFGTB CH-5 (0.044 tonnes) followed by CH-2(0.028 tonnes), CH- 4 (0.026) and minimum carbon stock was found in CH-1 (0.016).Thus, Clone CH-5 is recommended for afforestation programmes due to its fast growth within short period of 2 years, short term yield and maximum carbon sequestration.

Keywords-*Casuarina equsetifolia, Yield, Biomass, Carbon sequestration, Growth performance*

INTRODUCTION

*Casuarina equisetifolia*L., commonly known as the Casuarina or Australian Pine, is a large, evergreen tree native to the coastal regions of Southeast Asia, Australia, and the Pacific Islands(Turnbull, 1990). It belongs to the family Casuarinaceae and is known for its unique appearance and adaptability to various environments. The Casuarina tree has gained popularity in many countries due to its numerous practical uses and ecological benefits.

C. equisetifolia is characterized by its slender, needle-like foliage, which gives it a resemblance to a pine tree. The tree can grow up to 30 meters (98 feet) in height, with a spreading canopy and a symmetrical, cone-shaped form. Its bark is rough and fissured, providing protection against harsh weather conditions, salt spray, and fire.

One of the most remarkable features of the *C. equisetifolia* is its ability to thrive in challenging coastal environments. It is highly adaptable to sandy or saline soils, and its deep root system helps it withstand strong winds and stabilize coastal sand dunes. This characteristic has made it a valuable tree for preventing erosion and protecting coastlines from storms and tidal waves.

The tree also plays a crucial role in ecological conservation. Its dense foliage provides shade and habitat for a wide range of bird species, making it a valuable component of coastal ecosystems. Additionally, the tree's fallen needles contribute to the accumulation of organic matter, enhancing soil fertility and supporting the growth of other plant species in its vicinity.

Furthermore, *C. equisetifolia* has various practical applications. Its timber is lightweight and durable, making it suitable for construction purposes, including building boats, furniture, and flooring. The wood also produces excellent quality pulp (Deepthi *et.al*, 2020). In some regions, the tree is cultivated for its nitrogen-fixing ability, which helps improve soil fertility and boost agricultural productivity.

Carbon sequestration refers to the process of capturing and storing carbon dioxide (CO_2) from the atmosphere or other sources to prevent it from contributing to climate change(Nair, 2003). The primary goal of carbon sequestration is to reduce the concentration of CO_2, a greenhouse gas, in the atmosphere and mitigate its impact on global warming.Thus, the present study growth performance and carbon sequestration of Casuarina clones was assessed in Jabalpur district of Madhya Pradesh.

MATERIALS AND METHODS

Experimental site

The study was carried out in the experimental area of Silviculture, Forest Management and Agroforestry Division, Tropical Forest Research institute, Jabalpur (Madhya Pradesh). The climate of the study area is semi-arid, receiving 1350 mm rainfall in a year. The minimum temperature ranges between 5.3 to 6.1°C during December to January, and maximum varies between 40 to 42°C during May to June, respectively. Soil condition of experimented area has low nutrient level.

Treatment Details of the field experiment

The study was conducted with 2 years old *C. equisetifolia* clones planted @ 1.5 m x 1.5 m spacing. There were 9 clones namely IFGTB CH-1, IFGTB CH-2, IFGTB CH-3, IFGTB CH-4, IFGTB CH-5, IFGTB CH-6, IFGTB CH-7, IFGTB CH-9, IFGTB CH-10.

Collection of Growth data

Growth parameters like height (m) and girth (cm) were recorded annually in each treatment with its replication. The height of standing tree was measured from the tip of the

leading shoot to the ground point with the help of Ravi's altimeterand girth was measured at breast height i.e., 1.37 m with the help of measuring tape (Chaturvedi and Khanna, 1982).

Management activity

The existing plantation was managed by pruning of lateral branches, weeding, irrigation, soil working and insect pest disease control at periodic interval during the growing period.

Estimation of Tree Biomass, Carbon Stock and Carbon Sequestration.

i. Volume of the tree: Cylindrical volume of the tree has been calculated by using formula given below: -

$$\mathbf{V = \pi (D/2)^2 \times L}$$

Where, V= Cylindrical volume of tree (m^3)

D = Diameter at breast height(m)

L = Height of the tree (m)

π = 3.1416

Shape of trees is generally not perfectly cylindrical and there is invariably some taper thus the cylindrical volume has to be multiplied by form factor of the species to estimate the actual volume of the tree. The form factor of *C. Equisetifolia* is 0.33 (Deepthi *et.al*, 2020). Thus,

Actual volume = Cylindrical volume x Form Factor

ii. Above ground biomass (AGB): The above ground biomass was estimated by non-destructive method using the following formula: -

Above Ground Biomass (t ha^{-1}) = Volume of tree × Species specific gravity

Species specific gravity data were obtained from Forest Research Institute (FRI, 1996).

iii. Below Ground Biomass (BGB): It is calculated by multiplying the above ground biomass by 0.26 factor as the root shoot ratio (Hangarge*et al*., 2012)

Below Ground Biomass(t ha^{-1}) = AGB x 0.26

iv. Total Biomass: It is the sum of above ground biomass and below ground biomass (Sheikh *et al*., 2011)

Total Biomass(t ha^{-1}) = AGB + BGB

v. Total Carbon stock (t ha^{-1}): Carbon stock was estimated from the total biomass by multiplyingwith IPCC default carbon fraction of 0.50 quoted by Ravindranath *et al*., (1997) as follows.

Carbon stock (tha^{-1}) = Total Biomass (t ha^{-1}) × 0.50

vi. Total Carbon dioxide sequestered (t ha^{-1}): The weight of CO_2 in trees is determined by the ratio of CO_2 to C is 44/12 = 3.67. Therefore, to determine the weight of carbon dioxide sequestered in the tree, multiply the weight of carbon in the tree by 3.67 (Johnson and Coburn, 2010).

Carbon dioxide sequestered (t ha^{-1}) = Carbon stock x 3.67

RESULTS AND DISCUSSION

Girth and Height

Girth and Height of the Casuarina clones were collected from its initial stage i.e., in first year (2020) year and second year (2022). Watering and weeding to the Casuarina plantation were given regularly. As the tree grows, the clones are pruned for the betterment of tree's growth. The average girth of the casuarina plantation is 11.2 cm, among all 9 Casuarina clones, IFGTB CH-5 measures a maximum average Girth at Breast height which is 13.64 cm followed by 13.13cm IFGTB CH-2 at GBH, about 12.15cm in IFGTB CH-9 at GBH. Along with GBH, the height of the plantation was also recorded, the clone IFGTB CH-2 measures a maximum height that is about 5.77m followed by the IFGTB CH-9 5.65m and IFGTB CH-5 5.62m. the average height of the plantation is 5.29m. The clone IFGTB CH-3 measures the minimum height of 4.63m (Fig.-1).

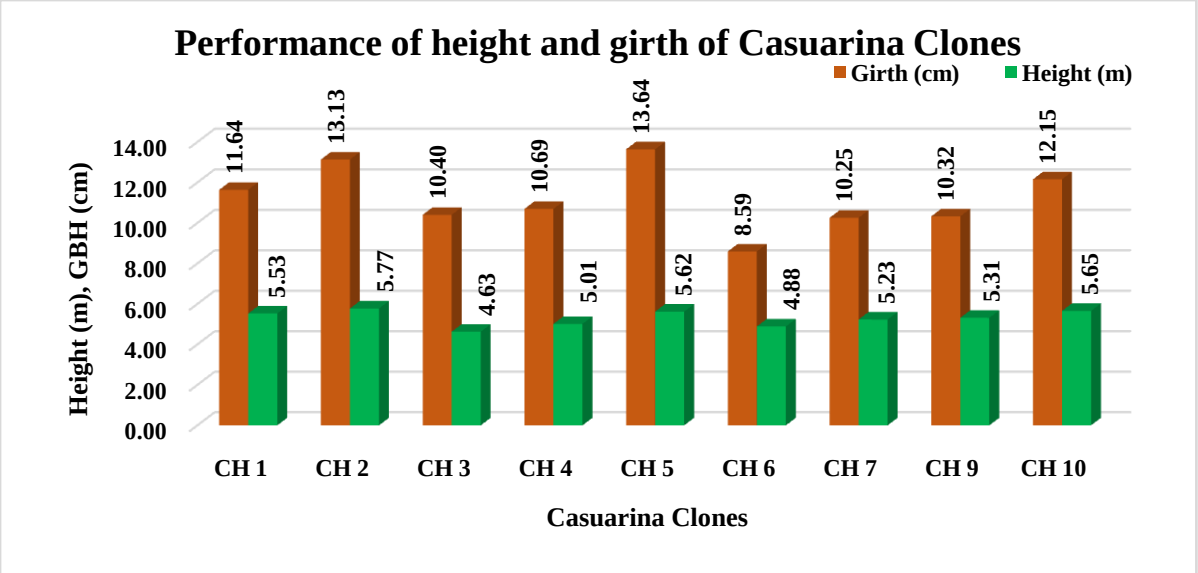

Fig.1- Average height and girth of Casuarina clones.

Volume and Biomass

The total volume production of the Clonal plantation is 0.310 m^{3}within 2 years. The clone IFGTB CH-5 produced the maximum volume per m^3 followed by the Clone IFGTB

CH-2 and IFGTB CH-4 because of the highest survival percentage among the all clones. The total biomass production of the casuarina plantation is 0.422 tons per 546.75m^2, then biomass production is 0.78 kgs m^{-2}. The maximum biomass was found in clone IFGTB CH-5 followed by IFGTB CH-2 and IFGTB CH-4. The minimum biomass was found in clone IFGTB CH- 1 because the volume and Biomass are correlated with each other (Fig.-2).

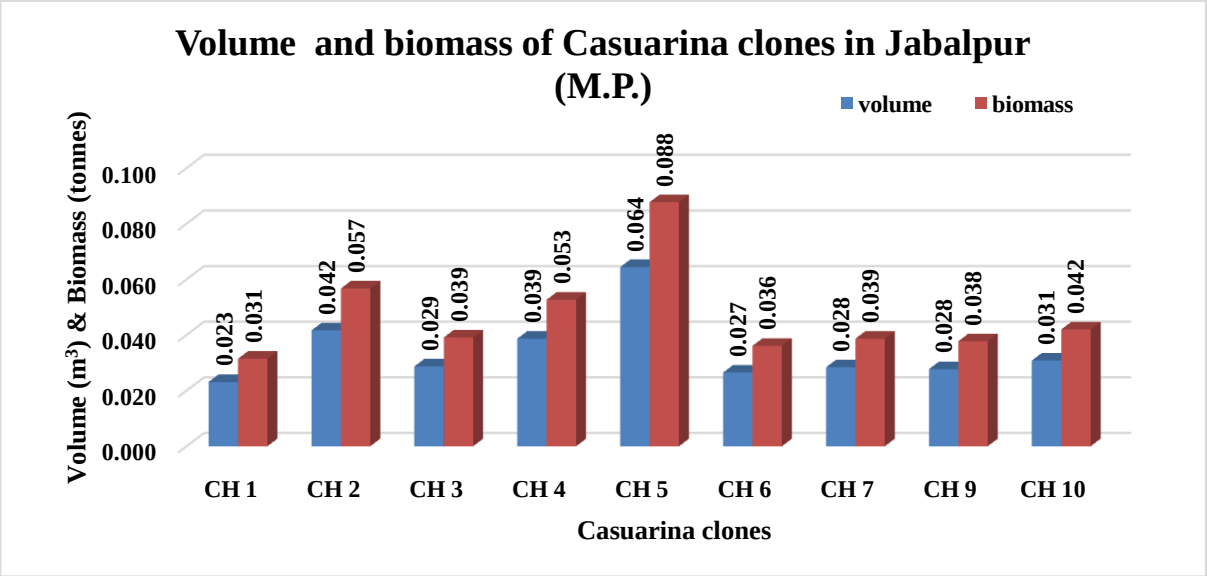

Fig.2- Volume and biomass of Casuarina clones.

Carbon and CO_2 sequestration potential

The total carbon stocks of the plantation was calculated i.e.0.21 tonnes, the maximum carbon stock was found in clone IFGTB CH-5 (0.044 tonnes) followed by CH-2 (0.028 tonnes), CH-4 (0.026) and minimum carbon stock in CH-1 (0.016). the carbon sequestration potential of the casuarina plantation is 0.77 tonnes (Fig.-3).

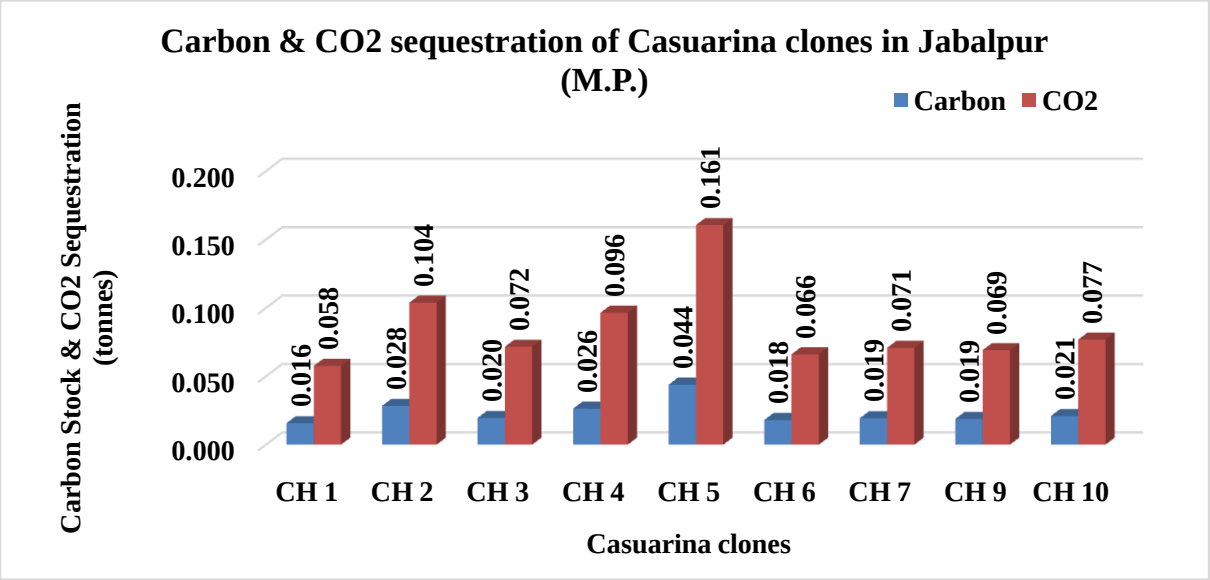

Fig.3- Carbon stock and CO_2 Sequestrationin Casuarina clones.

Growth performance

The Analysis of Variance shown significance difference among the Casuarina clones in study area. For girth at breast height (GBH), there are significant difference within the clones. The IFGTB CH-5 & CH-2 clones significantly differ from CH-4, CH-3, CH-8, CH-7 & CH-6 clones and at par with CH-9 & CH -1 clones at 5% level of significance, similar results were observed for clones IFGTB CH-2 & CH-5 in Andhra Pradesh by Nicodemus *et. al.,* (2020) and in Punjab by Garg *et. al.,* (2021). From this study it was observed that the clone IFGTB CH-5 is suitable for huge plantation because of its desirable characteristics that can produce more volume among the different clones to get more income within short period of its plantation.

CONCLUSION

As per the study, the clone CH-5 attains maximum growth as well as sequesters maximum carbon as compared to other clones. Thus, CH-5 clones are recommended for afforestation for getting better yield and high carbon sequestration particularly in tropical region of Jabalpur (Madhya Pradesh).

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