Sustainable fertigation practices for improved nutrient management in *Casuarina* clones – a field study from farmlands of Tamil Nadu, India

S. Navaneetha Krishnan[1], A. Balasubramanian[1,*], S. Radhakrishnan[1], I. Sekar[2], T. Chitdeshwari[3], S. Varadha Raj[4], M. Sivaprakash[1], B. Sivakumar[1], C. N. Hari Prasath[1], G. Swathiga[1] and K. S. Anjali[1]

[1]Department of Silviculture and Natural Resource Management, Forest College and Research Institute, Mettupalayam 641 301, India
[2]Department of Agroforestry, Forest College and Research Institute, Mettupalayam 641 301, India
[3]Department of Sericulture, Forest College and Research Institute, Mettupalayam 641 301, India
[4]Department of Basic and Social Science, Forest College and Research Institute, Mettupalayam 641 301, India

The increasing need for sustainable agricultural practices resulted in the exploration of fertigation techniques that optimise nutrient management, enhance soil health, and promote crop productivity. The present study examined the influence of sustainable fertigation practices on soil nutrient dynamics and growth performance in *Casuarina* clones cultivated across various farmlands in Tamil Nadu, India. Based on agricultural factors, daily rainfall, evapotranspiration, and fertiliser dosage, the recommended dose of fertiliser (RDF) of 200 : 200 : 300 gm/plant/year, irrigation was scheduled according to the tree's computed water need as potential evapotranspiration or pan evaporation (PE). The spacing regimes (1×1 m, 1.2×1.2 m, 1.5×1.5 m and 1.8×1.2 m) was distributed as main plot; irrigation treatment combinations (50 %, 75%, 100% and 125% PE) was assigned as subplot I and fertiliser combinations (75%, 100%, 125% and 150% RDF) was assigned as subplot II. The growth parameters recorded in relation to basal diameter (cm), height (cm) and volume index (cm^3) were analysed during growth stages 5 months after treatment (MAT) and 10 MAT. At 5 MAT, I_4F_4 (125% PE, 150% RDF) attained maximal height (78 cm), whereas basal diameter (0.324 cm) and volume index (16.758 m^3) were recorded maximum at I_3(I-Irrigation)F_3(F-Fertigation) (100% PE, 125% RDF). At 10 MAT, I_4F_3 (125% PE, 125% RDF) obtained maximal height (89 cm) and volume index (33.3 m^3), whereas I_3F_2 (100% PE, 100% RDF) catalouged maximal basal diameter (0.374 cm). Using resources sustainably, the present study helps standardise the crop's water and fertiliser requirements, increasing *Casuarina* productivity and output.

Keywords: Biometric attributes, clones, correlation, crop factor, fertigation.

*For correspondence. (e-mail: balasubramanian.a@tnau.ac.in)

CASUARINA species, particularly *Casuarina equisetifolia* and its hybrids, have become integral to agroforestry systems, fuelwood production and the pulpwood industry, due to their nitrogen-fixing ability, faster growth rate and adaptability to a diverse set of soil types[1–3]. The introduction of genetically superior clones has further improved the productivity and adaptability of *Casuarina* plantations[4]. These clones exhibit enhanced growth traits, disease resistance and wood quality, making them ideal for commercial cultivation. However, achieving optimal yield from *Casuarina* clones requires effective nutrient management, and fertigation has emerged as a promising technique in this respect[5]. Fertigation, the combined application of water and fertilisers through irrigation, offers a more efficient and targeted nutrient delivery system compared to conventional methods. Fertigation increases nutrient absorption efficiency and decreases waste by guaranteeing the regulated flow of nutrients straight to the plant root zone[6]. In the context of *Casuarina* clones, which require balanced nutrients for sustained growth, fertigation provides a means to optimise both water and nutrient availability[7]. The ability to deliver fertilisers at critical growth stages ensures that the clones receive the necessary nutrients in the right proportions, promoting healthy root and shoot development.

The yield of *Casuarina* clones is influenced by several factors, including genetics, environmental conditions and management practices[8]. Fertigation has been shown to positively affect biomass accumulation, wood volume and overall yield in *Casuarina* plantations[9]. Studies have indicated that fertigation can enhance nutrient-use efficiency, leading to faster growth rates and increased yield potential[10]. The precise application of nutrients, especially nitrogen and phosphorus, through fertigation results in better canopy development, improved root systems and higher survival rates, contributing to enhanced productivity in the long term[11]. One of the key advantages of fertigation is its role in improving water-use efficiency. *Casuarina* clones, while drought-tolerant, benefit from consistent