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Full Length Research Paper

A new record of abnormal phylloclad modification in *Casuarina equisetifolia*

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Phenotypic variants have been reported in *Casuarina equisetifolia* throughout the distribution range in India on crown shape, branch angle, phylloclad length, size and shape of infructuscence and seed morphology. This correspondence is a report of abnormality in the phylloclad recorded in this species. As a part of the tree improvement programme of the Institute of Forest Genetics and Tree Breeding, Coimbatore, India, clones identified for high productivity were tested in a sodic region in India. Out of 87 clones tested in replications, one clone revealed an abnormal phylloclad modification at the end of one year. The phylloclad which should have been cylindrical was observed to open out resembling a hand fan. The width at mid region of the modification varied from 2.5 to 7.0 cm with the mid diameter ranging from 1.79 to 3.47 mm, almost 3-6 times the normal measurements. The length of the structure varied from 4.6 to 12.8 cm. There were six such modified phylloclads in the clone. No such observations have been recorded earlier, nor has there been any report in the same field in other clones following this occurrence. The reasons for this abnormality need to be investigated. It could be attributed to physiological stress in the plant.

Key words: Casuarina, phylloclad, stress physiology, salt stress, fasciation.

INTRODUCTION

Casuarina equisetifolia L., the most widely cultivated species of *Casuarinaceae* in India, belongs to the order Casuarinales, a distinctive group of angiosperms. Due to their peculiar structure, they have remained something of an enigma taxonomically and phylogenetically (Subramanian et al., 1992). A characteristic feature of Casuarinaceae is the conifer-like appearance due to their hanging green branchlets and cone-like fruits. The stem is composed of two parts: indeterminate persistent branches which, after secondary thickening, form the permanent above-ground plant body and determinate deciduous branchlets (incorrectly referred to as cladodes) of about 0.4 to 0.6 mm in diameter (Torrey and Berg, 1988) (Figure 1). The needle like branchlets, which are the major photosynthetic organs of the plant, dividing into almost regularly spaced nodes is another characteristic feature of this family. These photosynthetically efficient branchlets, cylindrical in shape, which fall off like the leaves after a particular duration are termed as phylloclad (Varghese, 1987). Leaves are minute, reduced and tooth like, arranged in the form of a cup at the nodes or joints of the phylloclads.

India is the largest planter of Casuarina in the world and it is estimated that about 500,000 ha are planted with *Casuarina* in the states of Andhra Pradesh, Orissa, Tamil Nadu and the Union Territory of Puducherry (Pinyopusarerk and Williams, 2000; Nicodemus, 2009). Multiple utility values and suitability in agrarian ecosystems have made *Casuarina* a farmer friendly tree species especially in the coastal regions of peninsular India. It has gained popularity in inland also. Its usefulness in environmental protection has been fully realized after the tsunami and is now a major component in any coastal afforestation programme in India (Nicodemus, 2007). Phenotypic variants have been reported on *C. equisetifolia* throughout the distribution range in India on crown shape, branch angle, phylloclad

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Figure 1. Stem of *Casuarina equisetifolia* showing indeterminate persistent branches and determinate deciduous branchlets.

length, size and shape of infructuscence and seed morphology (ICFRE 1994; Kumar and Gurumurthi, 1998; Prasad and Dieters, 1998). However, abnormality in phylloclad structure has not been reported in this species till date.

MATERIALS AND METHODS

The Institute of Forest Genetics and Tree Breeding (IFGTB), Coimbatore has the largest germplasm of Casuarina in India. Around 400 clones of this species are available with IFGTB and are under various stages of testing and release for commercial planting. The species has been continually tested since 1996 in problem soils to screen for hardy clones (Warrier and Venkataramanan, 2011). As a part of this venture, 87 clones identified for high productivity were tested in Pugalur, Tamil Nadu (N 11° 01.933' E 78° 01.121'), a sodic region with an exchangeable sodium percentage (ESP) of 46.50, pH and electrical conductivity (dSm^{-1}) 8.4 and 1.87 respectively. The field experiment was laid out in Randomized Incomplete Block Design with 6 replications (3 ramets per replication) at 3x1.5 m spacing. Six monthly observations on quantitative data (tree height and dbh) and yearly observations on qualitative data (axis persistence, verticality, stem straightness, branching pattern, reproductive status and health status) had been recorded from the experiment (Warrier et al., 2007). This correspondence is a report of abnormality in the phylloclad recorded in *C. equisetifolia*.

RESULTS AND DISCUSSION

Out of the eighty-seven tested in six replications, one clone revealed an abnormal phylloclad modification at the end of one year after planting. The phylloclad which should have been cylindrical was observed to open out resembling a hand fan (Figures 2 and 3). The width at mid region of the modification varied from 2.5 to 7.0 cm with the mid diameter ranging from 1.79 to 3.47 mm, almost 3 to 6 times the normal measurements. The length of the structure varied from 4.6 to 12.8 cm. There were six such modified phylloclads in the clone. No such observations have been recorded earlier, nor has there been any report in the same field in other clones following this occurrence.

Different types of plasticity, operating at different levels within individuals or across generations have been recognized in plants. Individuals raised under extreme environmental conditions usually present considerable phenotypical distortion often associated with abnormal growth (Torrey and Berg, 1988). The reasons for this abnormality need to be investigated. It could be attributed to physiological stress in the plant. This observation is of significance as it points towards the response of the species to stressed environments. Fasciation, which

Figure 2. Abnormal phylloclad modification of *Casuarina equisetifolia*.

Figure 3. Abnormal phylloclad modification of *Casuarina equisetifolia*.

literally translates to banding or bundling has been reported in some genera including *Acer, Euphorbia, Prunus* and *Salix.* Fasciation is thought to be caused by a hormonal imbalance. However, the exact nature of the

signals responsible for the hormonal change in the plant has not yet been identified. In some cases, this imbalance could be a random genetic mutation or, in other cases, induced by one or more environmental factors, including bacteria, fungi, virus, insects, frost and physical damage to the growing point. Fasciations are reported in more than 100 vascular plant species (Tang and Knap, 1998) affecting dicots and monocots in 39 plant families and 86 genera (Goethals et al., 2001).

Casuarina equisetifolia has also been reported as a species showing anomalies in sex expression as a result of repeated hedging (Warrier et al., 2001). This observation on plasticity in vegetative characters also suggests that an in-depth analysis of its molecular physiology could provide an insight into its evolutionary process, throwing more light on this enigmatic species.

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