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Essential oil constituents and RAPD markers to establish species relationship in *Cymbopogon* Spreng. (Poaceae)

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Abstract

Nineteen *Cymbopogon* taxa belonging to 11 species, two varieties, one hybrid taxon and four unidentified species were analysed for their essential oil constituents and RAPD profiles to determine the extent of genetic similarity and thereby the phylogenetic relationships among them. Remarkable variation was observed in the essential oil yield ranging from 0.3% in *Cymbopogon travancorensis* Bor. to 1.2% in *Cymbopogon martinii* (Roxb.) Wats var. *motia*. Citral, a major essential oil constituent, was employed as the base marker for chemotypic clustering. Based on genetic analysis, elevation of *Cymbopogon flexuosus* var. *microstachys* (Hook. F.) Soenarko to species status and separate species status for *C. travancorensis* Bor., which has been merged under *C. flexuosus* (Steud.) Wats were suggested towards resolving some of the taxonomic complexes in *Cymbopogon*. The separate species status for the earlier proposed varieties of *C. martinii* (motia and sofia) is further substantiated by these analyses. The unidentified species of *Cymbopogon* have been observed as intermediate forms in the development of new taxa.

Keywords: Aromatic grasses; *Cymbopogon*; Essential oils; RAPD; Genetic diversity; Species relationships

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1. Introduction

The genus *Cymbopogon* (Poaceae) is known to include about 140 species. Among these, more than 52 have been reported to occur in Africa, 45 in India, six each in Australia and South America, four in Europe, two in North America and the remaining are distributed in South Asia (Jagadish Chandra, 1975b). Most of these species produce characteristic aromatic essential oils that have commercial importance in perfumery, cosmetics and pharmaceutical applications. The *Cymbopogon* essential oils are characterised by monoterpene constituents like citral, citronellol, citronellal, linalool, elemol, 1,8-cineole, limonene, geraniol, β-carophyllene, methyl heptenone, geranyl acetate and geranyl formate. Citral is one of the important components of the oil present in several species of *Cymbopogon* with wide industrial uses such as raw material for perfumery, confectionery and vitamin A.

After Sprengel named this genus in 1815, a number of taxonomists have attempted to classify the species of *Cymbopogon*. Hackel (1887) and Hooker (1897) have treated this genus as a subgenus of *Andropogon*. However, Stapf (1906) raised *Cymbopogon* to its original rank of a genus and this has been accepted by all the later taxonomists. Taxonomically, the species of *Cymbopogon* have been divided into three series viz. 'Shoenanthi', 'Rusae' and 'Citrati' (Stapf, 1906). The leaves of the species in 'Schoenathi' series are thin, in 'Rusae' subcordate and in 'citrati' lanceolate. The identification and classification of *Cymbopogon* species have become difficult because of the occurrence of numerous transitional forms which are supposed to have arisen by hybridisation (Bor, 1960) and the existence of many varieties and races (Jagadish Chandra, 1975a). Some species, such as *Cymbopogon citratus*, are not known to flower, others like *Cymbopogon nardus* and *Cymbopogon winterianus* flower only rarely and the polyploid forms of *Cymbopogon flexuosus* and *Cymbopogon coloratus* flower, but do not set seed.

The morphological variation and oil characteristics of various species and varieties of *Cymbopogon* have been reported (Husain, 1994), but such information is not sufficient to define precisely the relatedness among the morphotypes and chemotypes. For instance, *C. martinii* var. sofia and *C. martinii* var. motia, are morphologically almost indistinguishable, but show distinct chemotypic characteristics in terms of oil constituents (Guenther, 1950). Conversely, phenotypically and taxonomically well distinguishable species produce oils of almost identical chemical compositions such as lemongrass oils from *C. citratus* and *C. flexuosus* (Anonymous, 1988). Such phenotypic traits, whether morphological or chemotypic are basically the phenotypic expression of the genotype, while DNA markers are independent of environment, age and tissue and expected to reveal the genetic variation more conclusively in assessing such variations. Introgression of various traits, intermittent mutations and selection through human intervention may lead to variation in chemotypic characters across geographical distributions (Kuriakose, 1995). While natural hybridisation may lead to the formation of morphological or chemotypic intermediates, defining taxa purely on this basis may not be appropriate. The earlier works on phytochemical (Patra et al., 1990; Dhar et al., 1993), biochemical and physiological parameters (Nandi and Chatterjee, 1987), development of