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Quantification of adaptation and essential oil quality composition of palmarosa under normal soil and wastelands in Inceptisol of Jammu, J&K

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ABSTRACT

Two sets of experiment were conducted for quantification of adaptive values and essential oil quality composition of Palmarosa grown under wasteland and normal soils in Inceptisols of Jammu, J&K. First set comprised of field experiment which was conducted at research farm of Indian Institute of Integrative Medicine to quantify adaptation in terms of morpho-economic parameters, herbage and essential oil yield. The plantations of Palmarosa were collected from wastelands of subtropical region of Jammu and introduced in research farm of Indian Institute of Integrative Medicine, Jammu, J&K. Adaptive values as growth response-coefficient (b) indicate well adaptability of the plant under normal soils of subtropical region of Jammu, J&K. In other set of experiment hydrodistilled oil were collected from plantation grown under wastelands in subtropical region of Jammu and normal soils from research farm of the institute for comparison of essential oil content and quality parameters of oil. Palmarosa growing on wastelands was very well adapted on normal soils. The essential oil content % was more in normal soils as compared to wasteland soils. Plant possessed 0.11to 0.48% essential oil in the whole plant, 0.02 to 0.05% in stalk, 0.46 to 0.54% in the flowering tops and 0.18 to 0.27% in the leaves grown on normal soils whereas essential oil in the whole plant ranged from 0.10 -0.46, 0.01 -0.03% in stalk, 0.43- 0.51 % in the flowering tops and 0.19 to 0.28% in the leaves grown on wastelands. GC-MS analysis showed the various major and minor chemical constituents of industrial importance viz. geraniol (50.98), geranyl acetate (27.42), linalool (2.28), neral (1.98), geranial (4.13). The percentage of chemical constituents viz. geraniol (48.89), geranyl acetate (27.01), linalool (2.32), neral (1.84), geranial (4.02) were comparatively lower in wastelands than normal soils.

Keywords: Wastelands, essential oil content and composition, *Cymbopogon martini*

INTRODUCTION

Palmarosa is referred to a variety of *Cymbopogon* viz *Cymbopogon martinii* (Roxb.)Wats. Var. *motia*. and also noted for their medicinal potential (Prashar *et al.*, 2003). Essential oil obtained from this grass species is rich in geraniol. It grows wild in the state of Madhya Pradesh, Maharashtra, Andhra Pradesh and Karnatka and also extensively cultivated in the state of Karnatka, Maharashtra, Uttar Pradesh, Punjab and subtropical regions of the India for geraniol content. Palmarosa essential oil is either steam or water distilled using the rich fresh –tops of the plants. It has pleasant mood uplifting properties besides being anti-bacterial, fungal, microbial and viral essential. The chemical composition of Indian Palmarosa oil distilled from flowering plants has been studied in detail (Maheshwari and Mohan, 1985; Maheshwari and Sethi, 1987). An attempt was made to quantify the adaptation and comparative analysis was made for various physico-chemical parameters of oil in normal soils and wastelands.

MATERIALS AND METHODS

The germplasm of *Cymbopogon martinii* was collected from various wastelands of subtropical region of Jammu. The soil was sandy to sandy loam in texture with slightly alkaline pH range ; 7.8-8.9(1:2.5 soil to water) and the mean values of organic carbon ,available N, P and K were 4.6g kg^{-1}; 210, 9.8 and 127 kg ha^{-1} respectively. The germplasm brought was cultivated at field research farm of Indian Institute of Integrative Medicine, Jammu. The experimental soil was sandy loam in texture with neutral pH 6.9 (1:2.5 soil to water); organic carbon 7.6g kg^{-1}; available N, P and K 204, 14.2 and 124 kg ha^{-1} respectively. Twenty plants were harvested for collecting hydrodistilled oil from two soil types viz. normal soils and wastelands. Various chemical constituents of oil were studied through GC-MS analysis and compared for various physico-chemical parameters.

Determination of Adaptive values: Adaptive parameters based on morphoeconomic

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characters were quantified as growth response - coefficient values (b) for each parameter i.e plant height, tillers per plant, fresh herbage plant^{-1} and essential oil yield plant^{-1} ^{by} regressing with their relative index values, as obtained from the mean of all entries at harvest minus grand mean of on the 1st year plantation and termed as Height Growth Index, Tiller Growth Index, Herbage Growth Index and Essential oil growth Index, respectively (Siddiqui and Garg, 1990).

Isolation of essential oils: The essential oils were obtained from the aerial parts of the plants by hydrodistillation method using a Clevenger – type apparatus. Triplicate distillates were performed in succession for each sample of 500 g of fresh herbage of each leafing stage/ growth stage. Oils obtained at each growth stages were dried over anhydrous Na_2 SO_4 and stored at 4^{o}C until used for chemical analysis.

Analysis of oil: Analysis of GC was carried out on a DELSI 121C chromatograph fitted with a 25mx 0.25mm CP wax 52CB capillary column with temperature programming from 50°C(5 min) to 220°C at 2°C/min. Injector and detector temperatures were set at 2°C/ min. Injector and detector temperatures were set at 240°C and 255°C and the split ratio was 1/60.GC- MS coupling was achieved using SIGMA 300 chromatograph coupled to an HP 5970 mass spectrometer fitted with a 50m × 0.3mm CP wax column which was temperature programmed from 60°C –240°C at 2 C/ min. Ionization voltage was 70 ev. Components were identified by comparison of mass spectra with those reported in literature (Pedersen *et al.*, 1991).

RESULTS AND DISCUSSION

Adaptation

Adaptive values as growth response coefficient (b) has been quantified for each morphoeconomic character viz. plant height, tiller number, fresh herbage and essential oil yield and termed as Height growth index, Tiller growth index, Herbage growth index and Essential oil growth index which is 1.0 (Table 1). It indicates well adaptability of the plant under normal soils after introducing the plantations from wastelands (Dutta *et al.*, 2018)in inceptisols of Jammu and also express its response similarity with respect to the growth index over all harvests.

Table 1: Adaptive values as growth response coefficient of *Cymbogon martini*

Growth Indices*	Growth response Coefficient (b)
Plant Height Growth Index	1.0
Tiller Growth Index	1.0
Herbage Growth Index	1.0
Essential oil Growth Index	1.0

**Based on three replicates*

Variation of essential oil content in normal soils and wastelands

Fresh leaves and flowering top of the plant were hydrodistilled (Makanda and Claude, 2000). The essential oil obtained was pale yellow, thin in consistency and strong aroma. The essential oil content % was more in normal soils as compared to wasteland soils. Plant possessed 0.11to 0.48% essential oil in the whole plant, 0.02 to 0.05% in stalk, 0.46 to 0.54% in the flowering tops and 0.18 to 0.27% in the leaves grown on normal soils whereas essential oil in the whole plant ranged from 0.10 -0.46, 0.01 -0.03% in stalk, 0.43- 0.51 % in the flowering tops and 0.19 to 0.28% in the leaves grown on wastelands (Table 2). The oil content was higest in inflorescence followed by the leaves and finally stalks as also reported by other workers(Thiem *et al.*, 2011).The variation of essential oil content(%) may be a result of variation in fresh herb weight grown on different location (Pala-Paul *et al.*, 2008). Suitable soil to a special crop depends on its texture, depth, level of water table, salinity, and alkalinity.

Table 2: Variation of essential oil content percentage of hydrodistilled Palmarosa oil in Normal soils and Wastelands

Soil Type	Whole plant (fr.wt.basis %)		Stalks (fr.wt.basis%)		Flowering Tops (fr.wt.basis%)		Leaves (fr.wt.basis%)	
	Range	Mean	Range	Mean	Range	Mean	Range	Mean
Normal soils	0.11 - 0.48	0.29	0.02-0.0.5	0.03	0.46 -0.54	0.50	0.18-0.27	0.23
Wastelands	0.10 -0.46	0.28	0.01 -0.03	0.02	0.43- 0.51	0.47	0.19-0.28	0.24

**Range and mean based on three replicates*

GC-MS composition of essential oil grown on normal soils and wastelands

The essential oil composition of hydrodistilled palmarosa oil grown on wasteland were examined (Shylaraz and Thomas,1992) and compared with those obtained from plants grown in normal soils. The oil was analysed by capillary GC and GC –MS. Nineteen constituents, which accounted for 94.52 % of the oil, were identified in normal soils, while it was 92.78% in wastelands (Table 3). The percentage of various major and minor chemical constituents was found to be relatively lower in wastelands soils as compared to normal soils. This may be attributed to the soil types (Hashemabadi and Kaviani, 2010 and Hendawy *et al.*, 2017) and change in soil texture ,a factor which plays a crucial role in determining the chemical and physical characterization of soil such as water holding capacity , nutrient reserves and drainage properties. Nutrient available in the nutritional environment of plants are capable of changing yield and essential oil composition.

Table 3: GC-MS of the *Cymbopogon martinii* oil grown on normal soils and wastelands

Components	Percentage	
	Normal soils	Wastelands
β-pinene	0.46	0.43
Cineole-1	0.24	0.23
Cis linalool oxide	0.58	0.57
Trans linalool oxide	0.27	0.26
Linalool	2.28	2.26
Neral	1.98	1.96
Geranyl Formate	2.57	2.53
Piperitone	tr	tr
Geranial	4.13	4.10
Geranyl acetate	27.42	27.93
Nerol	0.07	0.06
Geraniol	50.98	48.99
Geranyl butyrate	0.31	0.29
Trans caryophyllene	0.53	0.52
Neryl hexanoate	0.18	0.17
Geranyl hexanoate	1.34	1.32
Geranyl 2- Methyl pentanoate	0.29	0.28
Farnesol-(E-E)	0.68	0.67
Farnesol-(Z.E)	0.21	0.20

**Based on three replicates*

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