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Variation in the yield and chemical composition of Eucalyptus species (Nilagiri) under different agro climatic condition of India

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Abstract
A trial was carried out during summer season of 2018, to know the variation in yield and chemical composition of Eucalyptus *species* under different agro-climatic regions of India. The sample collected from different parts of India *viz*., Northern, Central and Southern region of India. From the trial it can be noticed that, the herbage yield obtained from northern region recorded higher herbage yield ((3415 kg ha^{-1}) compared to rest of the region and was followed by central region (3085 kg ha^{-1}). However, the oil collected from southern region recorded higher per cent of oil (1.1%) and oil yield (30.6 kg ha^{-1}) as compared to rest of the region and was followed by central region. Chemical composition with regard to α-pinene, β-pinene and 1-8 cineole + limonene also varies with different agro-climatic condition. Essential oil collected from southern region shows higher per cent of α-pinene (23.53 %) and 1-8 cineole + limonene (66.43 %) compared to rest of the region and was followed by central region (20.19 % & 28.45 %). Whereas, β-pinene was higher in case of central region (17.17%) compared to others and was followed by northern region (4.58 %).

Keywords: Eucalyptus, essential oil, chemical composition and agro climatic condition

1. Introduction
Eucalyptus is an aromatic tree species belongs to the angiosperm family Myrtaceae. Eucalyptus species grow in a wide range of climatic and edaphic condition in their natural habitats. The genus includes more than 700 species, most being endemic to Australia. The history of eucalypt introductions and subsequent domestication in exotic environments has been reviewed by Eldridge (1994) [1]. Following the first record in Australia in the late 18th century, eucalypts were spread rapidly around the world into countries such as India France, Chile, Brazil, South Africa and Portugal (Iglesias-Trabado and Wisterman, 2008) [2]. The oil is of commercial importance, thus finds a large-scale use in perfumery and pharmaceutical industry. However, the amount and composition of oil varies with the species. The oils from Eucalyptus leaves have long been extracted and used in various commercial and medicinal capacities. In medicine, such oils have been used to relieve the symptoms of respiratory tract infections and inflammations, and reduce the effects of asthma (Juergens *et al*., 2003) [3]. The leaves also are known to have antiseptic properties and are used in traditional Guatemalan and Cuban medicine to treat skin conditions and lower high blood sugar levels. While more than 2.5 lakh hectares of forest and rainfed farmland have been diverted for eucalyptus plantations in the southern region state of Karnataka and Andhra Pradesh, in the North-western States of Punjab and Haryana, eucalyptus plantations account for nearly 1.5 per cent of the total land under cultivation. About 7.5 million hectares of land is currently under eucalyptus plantations in Indian region, accounting for about 8% of the global coverage. However, its performance under the different agro-climatic condition In Indian Region is not reported before. Therefore, the present study was carried out with an objective to correlate the agro-climatic condition in Indian Region with oil content and oil quality of Eucalyptus *species* (Nilagiri) in terms of herb yield and quality in different agro-climatic zones of northern, central and southern region of India.

2. Material and Methods
Sampling and analysis of fresh leaves of Eucalyptus *species* (Nilagiri) were done during summer season, 2018 which was collected from different region of India and categorized as North region Sample, Central region sample and Southern region sample of India and it was collected from site of an area of 100 sq. mt and estimated to yield per hectare. Harvested leaves were sub sampled and hydro-distilled in Clevenger-type apparatus for 3 h to extract the

essential oil. The moisture from the oil was removed by anhydrous sodium sulphate, then measured and stored at 4°C prior to isolation. Gas chromatography (GC) analysis for GC, a Perkin-Elmer Auto System XL gas chromatograph was used fitted with an Equity-5 column (60 m x 0.32 mm i.d., film thickness 0.25 µm; Supelco Bellefonte, PA, USA). The oven column temperature ranged from 70 to 250°C, programmed at 3°C/min, with initial and final hold time of 2 min, using H2 as carrier gas at 10 psi constant pressure, a split ratio of 1:30, an injection size of 0.03 µL neat, and injector and detector (FID) temperatures were 250 and 280°C, respectively. Characterization was achieved on the basis of retention time (RT), Kovats Index (KI), relative retention index using a homologous series of n-alkanes (C8-C25 hydrocarbons, Polyscience Corp. Niles IL), coinjection with standards in GC-FID capillary column, mass spectra library search (NIST/EPA/NIH version 2.1 and Wiley registry of mass spectral data 7th edition) and by comparing with the mass spectral literature data (Adams *et al*., 2001) [4]. The relative amounts of individual components were calculated based on GC peak areas without using correction factors.

3. Results and Discussion

3.1 Effect of agro climatic variation on oil yield and herbage yield of eucalyptus *species* (Nilagiri)

From the trail it can be noticed that the herbage yield data collected from different region of India shows that Eucalyptus *species* that grown in northern region recorded higher herbage yield (3415 kg ha^{-1}) compared to rest of the region and was followed by Central India region (3085 kg ha^{-1}). The lowest herbage yield was noticed in southern region (2785 kg ha^{-1}). The yield increase was to an extent of 10.7 % and 18.4 % over central India and southern region. The herbage yield data was depicted in figure 1. These attributes are might be due to variation in rainfall, temperature, Relative humidity and nutritional level of the soil which inturn influence the yield and quality of the crop due to this the variation with regard to herbage yield was noticed in Eucalyptus *species* under varied climatic condition. These results are corroborate with the findings of Atwell *et al* (1999) [5].

Oil % and oil yield were varied with regard to different agro climatic condition and was higher in case of southern region (1.1 % and 30.6 kg, respectively) compared to central region (0.9% & 27.7 kg) and northern region (0.78% & 26.6 kg). The essential oil per cent and essential oil yield were higher in southern region to an extent of 18.2 & 9.48 and 29.09 & 13.07, respectively, over central and northern region. These attribute is might be due to congenial environment in the southern region for synthesis secondary metabolites led to increase in oil per cent as well as oil yield compared to central and northern region. The data with regard to oil per cent and oil yield were depicted in Figure 2.

3.2 Variation in chemical composition of eucalyptus due to agro-climatic condition

In Eucalyptus *species* (Nilagiri) the main chemical compounds which are considered are α-pinene, β-pinene and 1-8 cineole + Limonene. Among different region, southern region recorded higher per cent of α-pinene (23.53 %) and 1-8 cineole + limonene (66.43 %) compared to central and northern region and was followed by central region (20.19 % & 28.45%, respectively). However, lower per cent of α-pinene, and 1-8 cineole + Limonene were noticed in northern region (1.16 % & 15.23 %). Whereas, higher per cent of β-pinene was noticed in central region (17.17 %) compared to other region and was followed by northern region (4.58 %). These parameters might be due to variation with regard to temperature, Relative humidity, soil factor and other environment factor caused variation in chemical composition under different climatic condition. From the trial it can be concluded that, the herbage yield was higher in case northern region. Whereas, oil per cent, oil yield and quality with regard to α-pinene and 1-8 cineole + Limonene was higher in southern region due to conducive environment for the synthesis of secondary metabolite led to increase in oil per cent and oil yield. The data pertaining to chemical composition were depicted in figure 3.

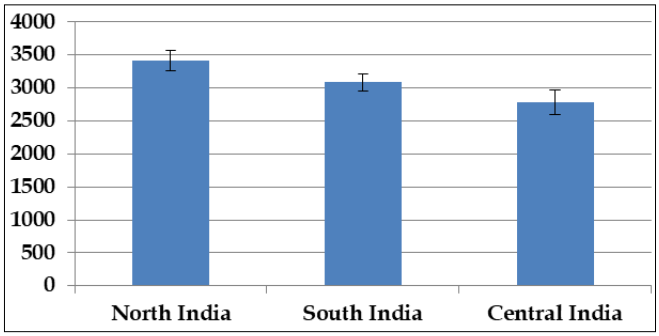

Fig 1: Herbage yield (kg/ha) of Eucalyptus species (Nilagiri) in different region of India

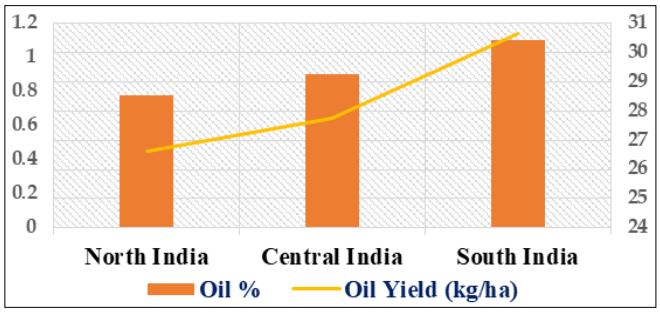

Fig 2: Oil content and Oil yield of Eucalyptus species (Nilagiri) in different region of India.

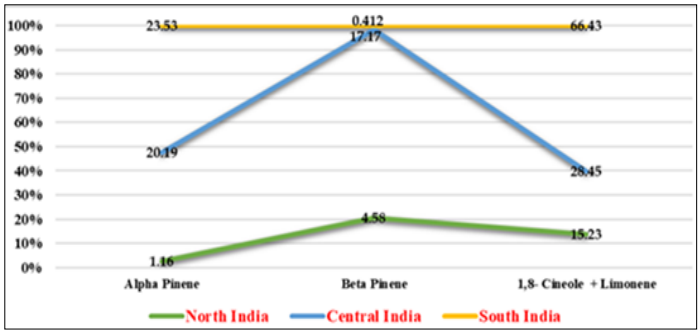

Fig 3: Chemical Composition (%) of Eucalyptus species (Nilagiri) in different region of India

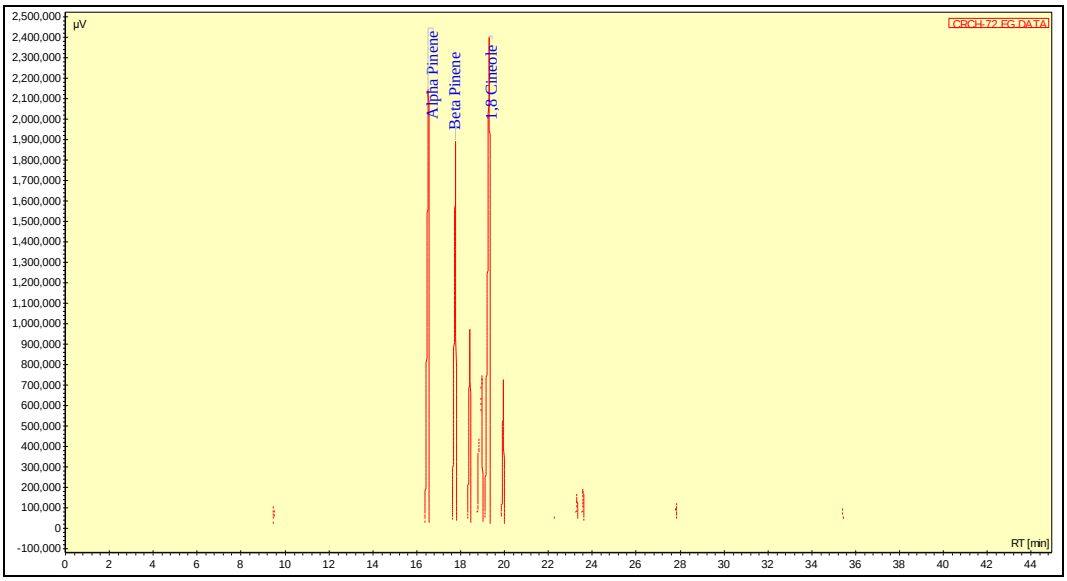

Fig 4: The Gas chromatogram of the Eucalyptus oil collected from Central region

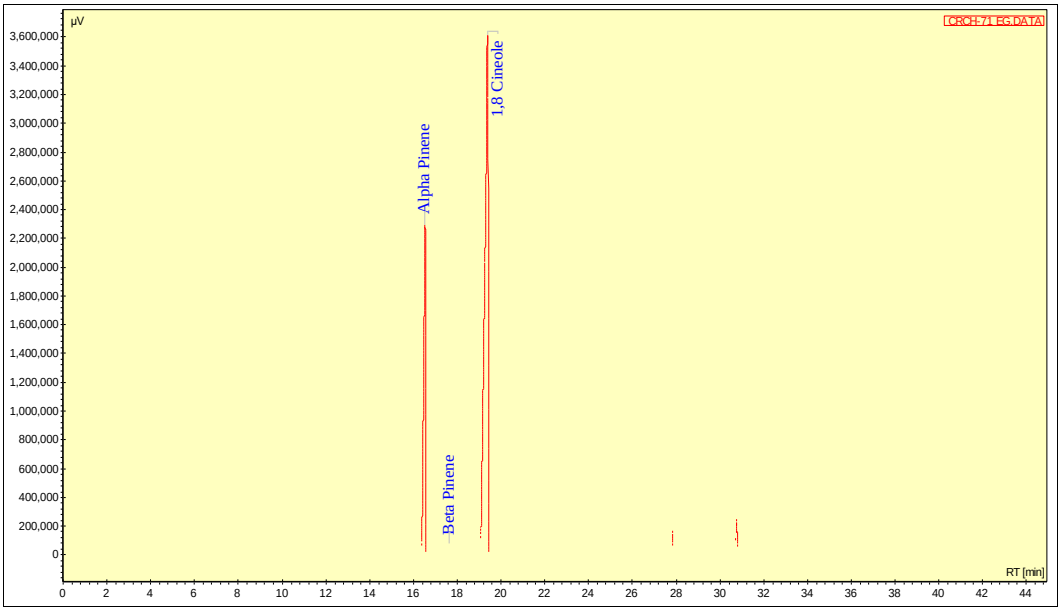

Fig 5: The Gas chromatogram of the Eucalyptus oil collected from Southern region

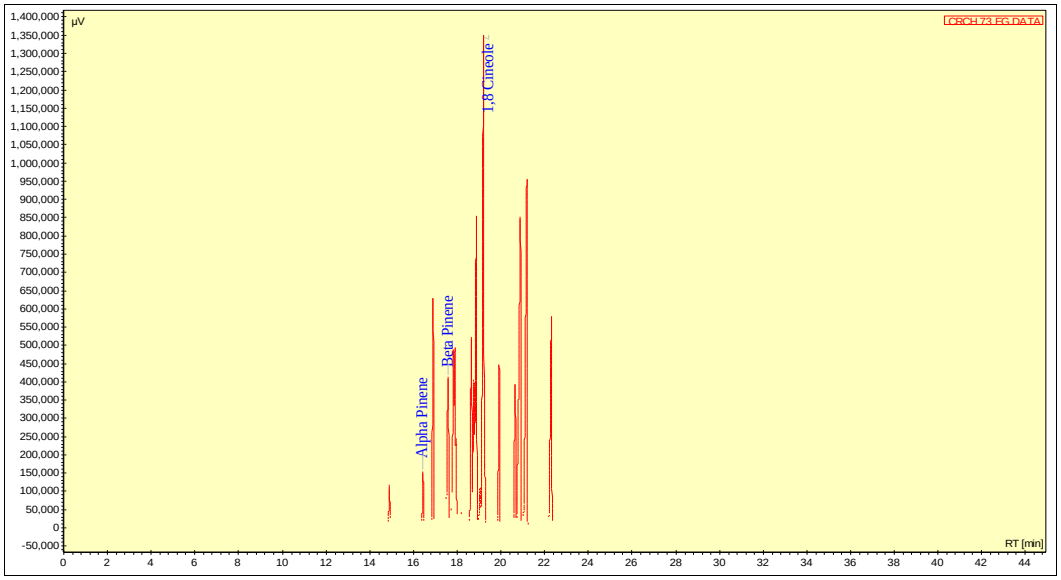

Fig 6: The Gas chromatogram of the Eucalyptus oil collected from Northern region

4. Conclusions

From the data gathered, it can be found that variation in soil, RH, temperature, wind and rainfall from region to region will alter the herbage yield, quality and chemical composition of Eucalyptus species. Due to availability of sufficient water have favourable effect on herbage yield in Northern region. However, quality and quantity of oil and chemical composition is very good in southern region due to congenial and favourable environment for the synthesis of essential oil and secondary metabolites led to increase the quality as well as quantity compared to central and northern regions of India.

5. Acknowledgements

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