

SESQUITERPENE HYDROCARBONS IN NEEDLES OF
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Key Word Index—*Pseudotsuga menziesii*: Pinaceae; Douglas fir; essential oils; sesquiterpene hydrocarbons; terpenes.

Plant. *Pseudotsuga menziesii* (Mirb.) Franco.
Source. Pacific Coast Range west of Ukiah, California.
Use. Important lumber species.
Previous work. On needles [1–4], wood [5], oleoresin [6–9].

Present work. Samples of essential oil were isolated from kg amounts of mature needles and of new tip growth (collected about 10 days after emergence) from Douglas fir by steam distillation of the macerated foliage, extraction of the distillate with *n*-pentane and removal of the solvent on a rotary evaporator at 100 mm and 0°. Isolation and purification of individual sesquiterpene hydrocarbons was by column chromatography and repetitive preparative GLC on columns chosen to optimize the particular separation. Identification of individual sesquiterpenes was by a combination of IR, MS, relative retention times and Kovats indices. The type of spectral evidence used for identification is indicated after each component.

Mature needles: α -*trans*-bergamotene (IR), α -bisabolene (IR), *isobisabolene* (IR), γ -cadinene (IR), δ -cadinene (IR), β -caryophyllene (IR), β -elemene (IR), α -humulene (IR), longifolene (IR), α -longipinene (IR), β -santalene (IR), sibirine (IR).

Young needles: α -*trans*-bergamotene (IR, MS), α -bisabolene (IR), δ -cadinene (IR), β -caryophyllene (IR), β -elemene (IR), germacrene D (IR, MS), α -humulene (IR, MS).

The investigation of the sesquiterpenes present in Douglas fir foliage was part of a long-term study of the food chain relationships of browsing ruminants with respect to the damage they do to industrially important browse species. The amounts of sesquiterpene hydrocarbons present in mature Douglas fir needles are in general very small with no particular component present in major amount. In the new tip growth germacrene D is one of the most abundant terpenes present (*ca* 5% of the essential oil) but it cannot be detected in the mature needles. Four sesquiterpene alcohols were isolated from the new tip growth but in amounts too small to permit identification. *p*-Cymene-8-ol, not previously reported in Douglas fir foliage, was identified from the new tip growth by its Kovats index and IR spectrum.

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