

**Zeitschrift:** Veröffentlichungen des Geobotanischen Institutes der Eidg. Tech. Hochschule, Stiftung Rübel, in Zürich

**Herausgeber:** Geobotanisches Institut, Stiftung Rübel (Zürich)

**Band:** 54 (1975)

**Artikel:** Ecological conditions limiting the distribution of *Fagus sylvatica* L. and *Abies alba* Mill. near Schwarzenberg (Lucerne) Switzerland

**Autor:** Gadekar, Hirasa

**Kapitel:** 3: Methods

**DOI:** <https://doi.org/10.5169/seals-308421>

### Nutzungsbedingungen

Die ETH-Bibliothek ist die Anbieterin der digitalisierten Zeitschriften auf E-Periodica. Sie besitzt keine Urheberrechte an den Zeitschriften und ist nicht verantwortlich für deren Inhalte. Die Rechte liegen in der Regel bei den Herausgebern beziehungsweise den externen Rechteinhabern. Das Veröffentlichen von Bildern in Print- und Online-Publikationen sowie auf Social Media-Kanälen oder Webseiten ist nur mit vorheriger Genehmigung der Rechteinhaber erlaubt. [Mehr erfahren](#)

### Conditions d'utilisation

L'ETH Library est le fournisseur des revues numérisées. Elle ne détient aucun droit d'auteur sur les revues et n'est pas responsable de leur contenu. En règle générale, les droits sont détenus par les éditeurs ou les détenteurs de droits externes. La reproduction d'images dans des publications imprimées ou en ligne ainsi que sur des canaux de médias sociaux ou des sites web n'est autorisée qu'avec l'accord préalable des détenteurs des droits. [En savoir plus](#)

### Terms of use

The ETH Library is the provider of the digitised journals. It does not own any copyrights to the journals and is not responsible for their content. The rights usually lie with the publishers or the external rights holders. Publishing images in print and online publications, as well as on social media channels or websites, is only permitted with the prior consent of the rights holders. [Find out more](#)

**Download PDF:** 23.01.2026

**ETH-Bibliothek Zürich, E-Periodica, <https://www.e-periodica.ch>**

### 3. Methods

#### 3.1 Phytosociological methods:

For characterizing the plant communities in the Guberwald, the methods of Zürich-Montpellier school of phytosociology were followed. Homogeneous places were selected for the relevés. The relevés were put into a vegetation table. All the details of this method are given in KNAPP (1971).

#### 3.2 Soil physical methods:

Tensiometer: For measuring soil water tension in the field, this simple and convenient instrument has been in use since RICHARDS (1942) demonstrated the usefulness of it in the field and described its construction and installation. BRUEHLHART (1969) successfully used tensiometers to characterise the seasonal changes of water tension and water retension and deep seepage in the forest soils of the Swiss Midlands.

For the present investigations, tensiometers were obtained from the Laboratory of Soil Physics ( Federal Institute of Technology). Six tensiometer stations were set up ( Fig. 4 ). At each station, three tensiometers were installed in the depths of 20 and 50 cm. Extra tensiometers were installed on podsol in the depths of 5, 10 and 15 cm. Before installations, holes were made with 22 cm auger. Airfree boiled water (KUEHNEL 1969) was used for filling the tensiometers. Between June and October 1972 and again May and October 1973, twice a week, tensiometer readings were made by the Corporation's forester.

Matrix potential can be measured by a hanging water column being in equilibrium to each other. The weight of this hanging water column per unit area is called negative pressure (-  $\text{g} \cdot \text{g} \cdot \text{h}$  ), or tension where  $h$  is the height of this column,  $\text{g}$  the density of water and  $g$  acceleration of gravity. The weight of this water column has the dimensions  $(\text{M} \cdot \text{L}^{-1} \cdot \text{T}^{-2})$  i.e. the dimensions of energy per unit volume of water. If we devide the expression  $\text{g} \cdot \text{g} \cdot \text{h}$  by the value  $\text{g} \cdot \text{g}$  ( i.e. by the weight per unit volume), we obtain a lengh  $h$  which we call tension-head. This tension-head is widely used as an index of matrix-potential as referred to the unit weight of water. It is mostly expressed in cm of water column.

Desorption curves: It is a graphical presentation of the relationship between soil water content and soil water tension when the soil is drying out. With the help of these curves, it is possible to estimate the amount of available water to plants.

Undisturbed soil samples were brought from four different soil profiles at depths of 10 to 20 and 40 to 50 cm. The water content of these samples was determined under extracting pressure equivalent of 1,5,10,20,40,80,160,345,650cm of water column and 2, 5, 10, 15 at in the Laboratory of Soil Physics ( ETH ). Calculations were made with standard computer program in the ETH "Rechenzentrum".

Particle size: It was determined with a hydrometer method described by DAY (1956). Soil samples after sieving were treated with hydrogen peroxide until the humus was completely destroyed. Calgon solution was used to prevent flocculation.

### 3.3. Soil chemical methods:

Soil reaction: Thouroughly mixed, fresh soil samples were sieved with a 4 mm sieve. A small quantity was added to a beaker with deionized water to make a thick liquid of it and kept for 5 hours. It was thouroughly stirred and the pH was measured with a glass electrode (ELLENBERG 1958 and STEUBING 1965).

Carbonate: It was measured with the Passon's apparatus. 5 g of dry soil (sieved 2 mm) was treated with 20% hydrochloric acid and the resultant carbondioxide was measured volumetrically. It is represented in percent content of 100g of soil.

Nitrate and Ammonium ions: For the determination of these ions the methods described by STEUBING (1965) and GIGON (1968) were used.

Fresh soil samples sieved with a 4 mm sieve were extracted with 1 % potassium-aluminium-sulphate solution. A part of the extract was used to determine ammonium ions with the micro-diffussion method described by CONVAY (1962). To the resulting solution, a drop of Nessler's reagent was added. Ammonium ions were determined colorimetrically. For the nitrate determination, the extract was treated with 2,4 - xylanol, distilled and measured colorimetrically.

Soil samples were then incubated in the humid chamber for six weeks and again nitrate and ammonium ions were determined as above.

Cations: The method described by STICHER et al. (1971) was followed. According to this method, samples sieved with 2 mm sieve were treated with ammonium-acetate and the individual ion concentration of  $\text{Ca}^{++}$ ,  $\text{Na}^+$ ,  $\text{K}^+$  and  $\text{Mg}^{++}$  was determined with a flame photometer. The sum of these ions represent the effective cation exchange capacity (S).  $\text{Al}^{+++}$ ,  $\text{Fe}^{+++}$ ,  $\text{Mn}^{++}$  ions were not determined as the amounts present are too small.

Exchangeable  $\text{H}^+$ -ions: Soil samples were treated with barium-acetate and the resultant extract titrated with sodium-hydroxide. Calculations were made to represent the values in  $\text{H}^+$  meq / 100 g soil.

Total cation exchange capacity: It was calculated by adding cations and  $\text{H}^+$ -ions. It is the percentage of effective cation exchange capacity in respect to total cation exchange capacity.

Base saturation: It was calculated as follows:

$$V \% = 100 \frac{S}{T}$$

Where  $V \%$  = Base saturation

$S$  = Effective cation exchange capacity

$T$  = Total cation exchange capacity

### 3.4 Germination and transplant experiments:

The seeds for all the germination experiments were procured from the seed dealing firm in Aarau (seed collected from Swiss Jura mountains).

1) Pots were filled with intact soil cores and put in the greenhouse. The other details of the experiments are explained in the results. Each pot has three replications and 30 seeds were sown in each pot. This experiment was started in the month of January and terminated in October 1973 and was repeated again in January 1974.

2) 36 plots, each of the size of one sq. meter were prepared as germination beds in the field. 100 seeds were spread systematically on each plot in January 1973.

3) Because of heavy seed damage due to birds and rodents, wire mesh cages were installed to protect the seeds in the field in the month of May 1973.

4) 20 beech seedlings ranging in age from 3 to 7 years were transplanted on the podsol. Tensiometers were installed in 5, 10, 15 cm depths so as to see the water stress in those horizons where the roots of transplanted beech seedlings were spreading.

In the germination experiments, the pots were watered daily with deionised water by prinkler. For having particular pH of deionised water, HCl was added to the water and pH was measured.