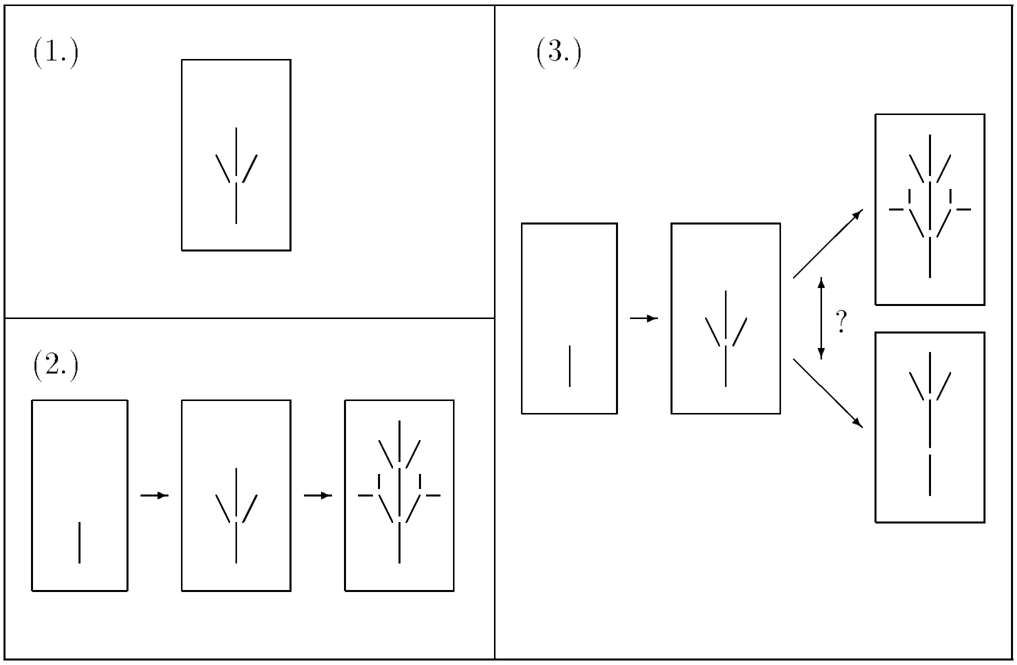


Fig. 1: The three levels of formal description of plant form.
(1) Statical description, (2) development, (3) control of development.

$$
\begin{tikzcd}
\alpha \arrow[r] & \sigma_1 \arrow[r] \arrow[d] & \sigma_2 \arrow[r] \arrow[d] & \sigma_3 \arrow[r] \arrow[d] & \cdots \\
 & S_1 & S_2 & S_3 & \ldots
\end{tikzcd}
$$

Fig. 2: Structure generation by a simple
growth grammar (L-system with interpretation).

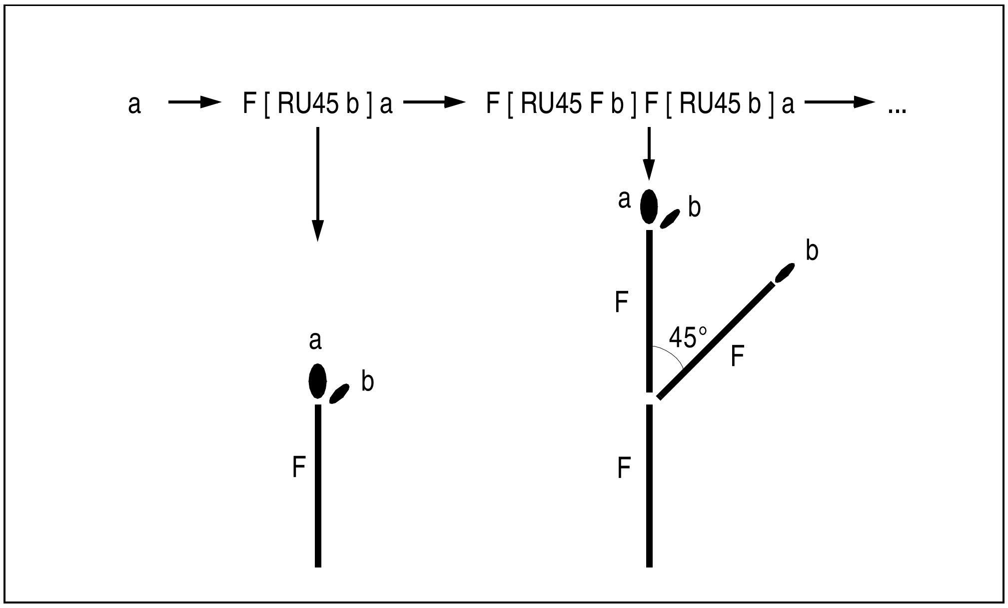


Fig. 3: Structure generation from the growth grammar
$a \longrightarrow \mathsf{F} \; [\; \mathsf{RU45} \; b \;] \; a, \quad b \longrightarrow \mathsf{F} \; b.$

$$
\begin{tikzcd}
\alpha \arrow[r] & \sigma_1 \arrow[r] \arrow[d, Rightarrow] & \sigma_2 \arrow[r] \arrow[d, Rightarrow] & \sigma_3 \arrow[r] \arrow[d, Rightarrow] & \cdots \\
& \sigma_1' \arrow[d] & \sigma_2' \arrow[d] & \sigma_3' \arrow[d] & \ldots \\
& S_1 & S_2 & S_3 & \ldots
\end{tikzcd}
$$

Fig. 4: Structure generation by a two-phase growth grammar

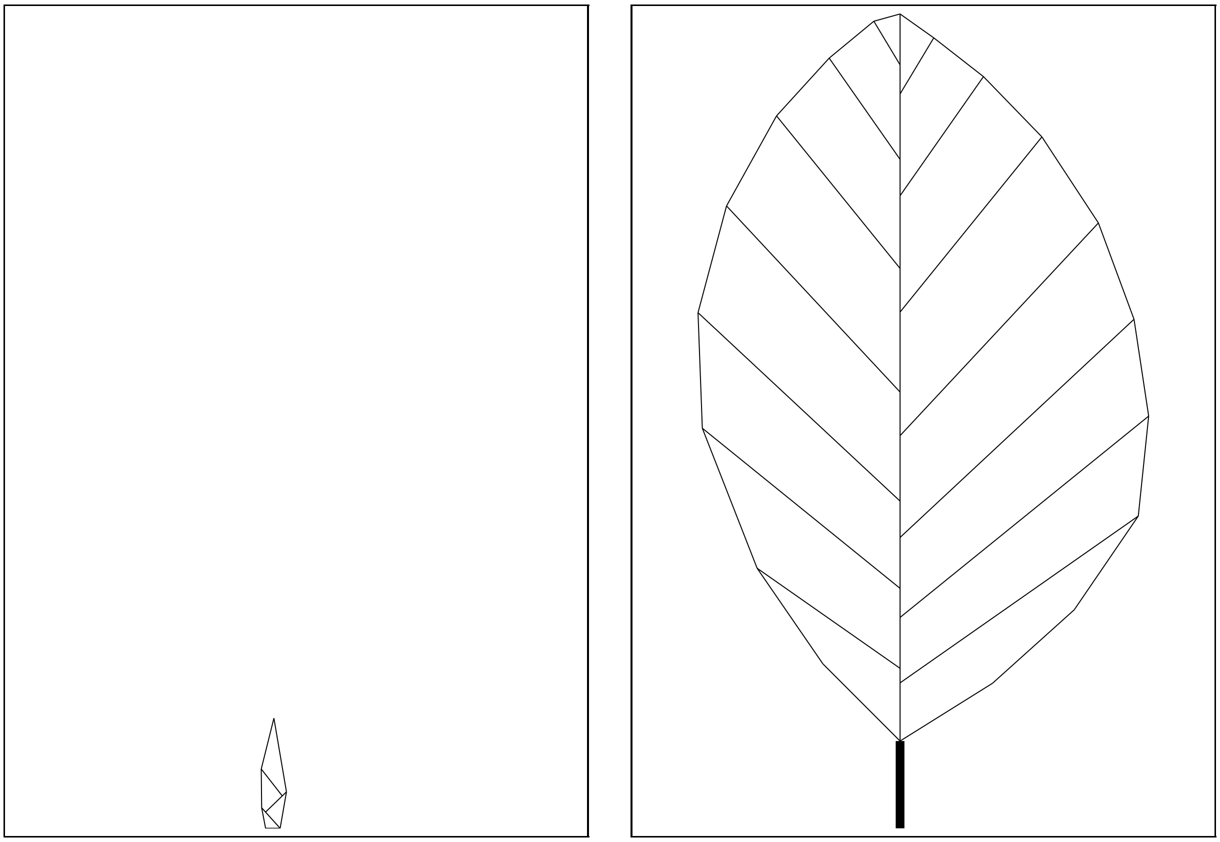


Fig. 5: Result of the submodels “bud” and “leaf” of the beech shoot growth grammar in Table 1, lines 1–5, 13 and 15–19.

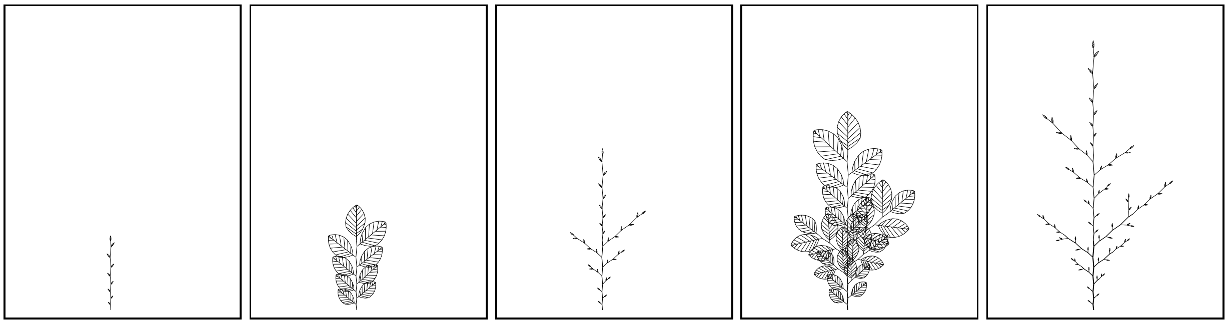


Fig. 6: Developmental steps 3–7 of the virtual beech branch specified by the growth grammar from Table 1, generated with GROGRA.

(More detailed view of single plates see last pages.)

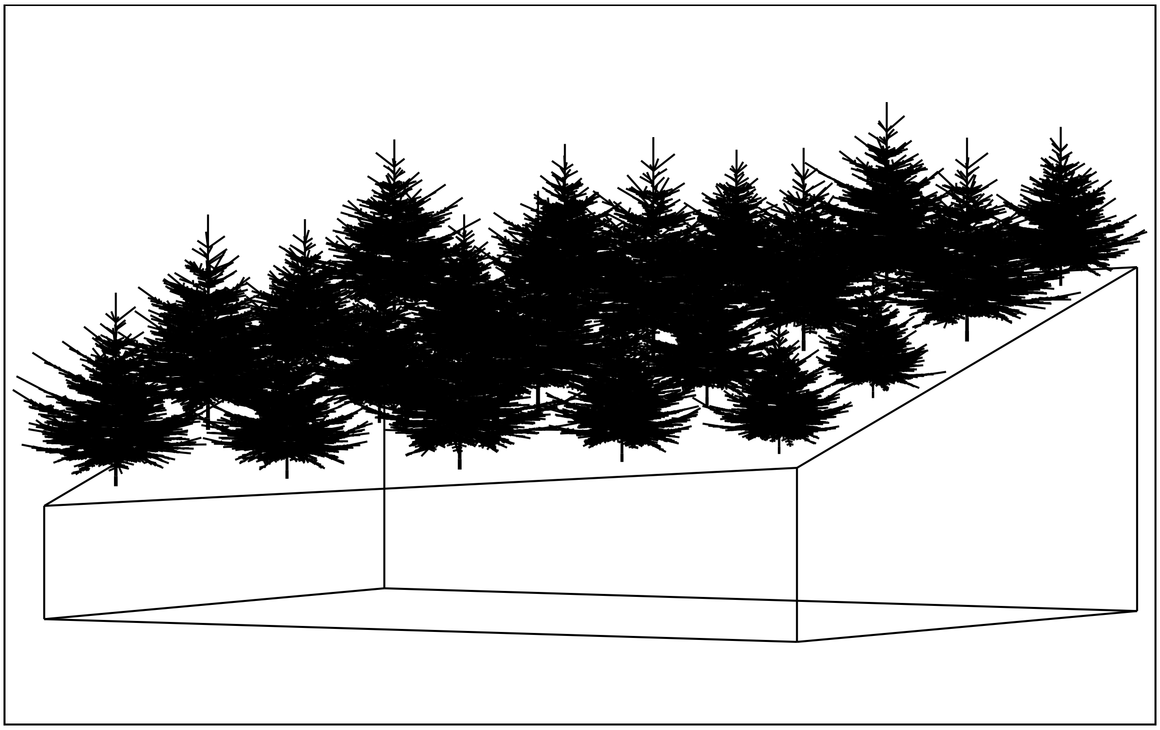


Fig. 7: Sloping spruce stand, generated by GROGRA from the grammar of Table 2 together with the spruce grammar from Kurth and Früh (1998), corresponding to age 10.

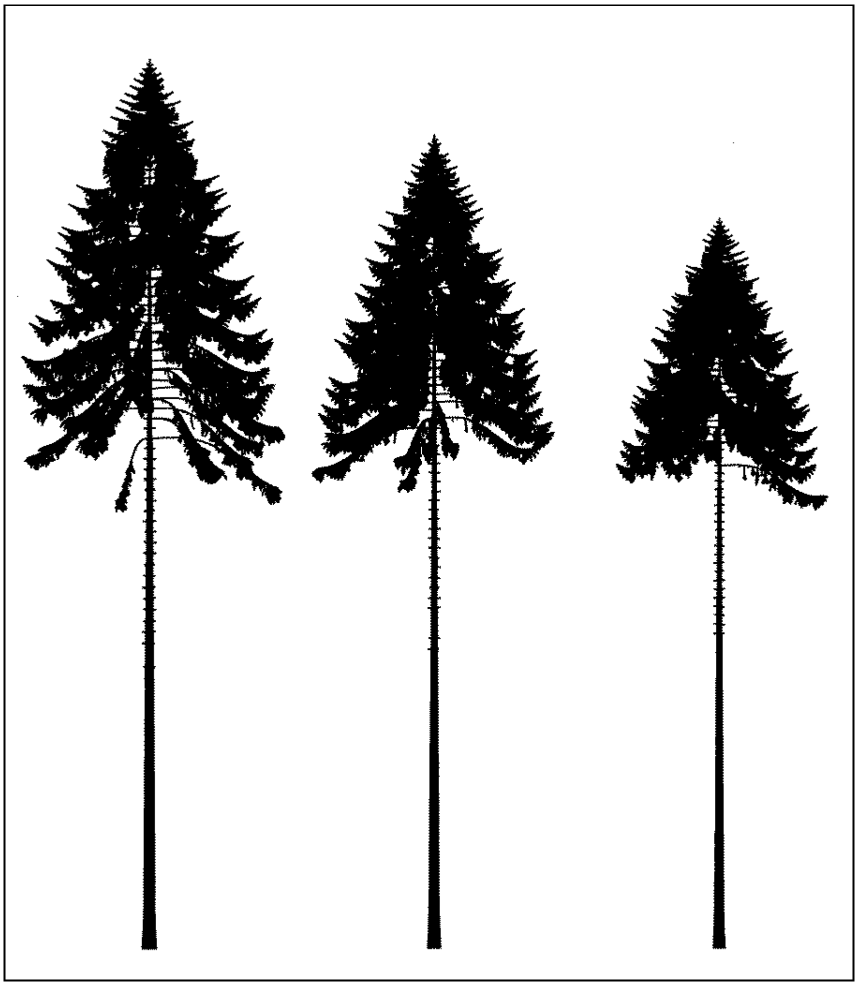


Fig. 8: 112 years-old spruce trees of 3 different social classes, generated by GROGRA.

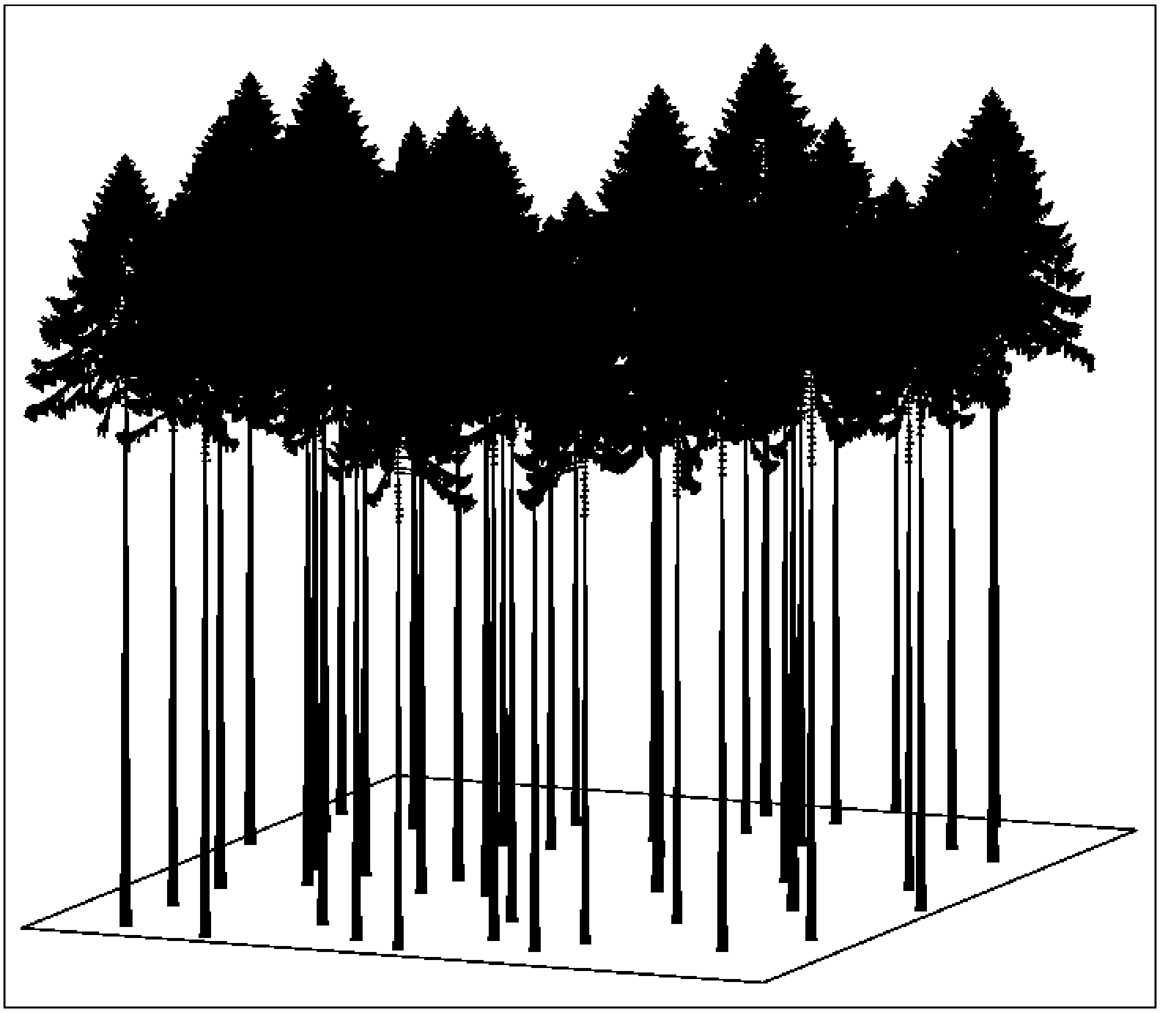


Fig. 9: Part of the experimental spruce stand Solling F1, generated by GROGRA from a growth grammar for aged spruce trees of 3 different social classes (cf. Fig. 8), together with a list of tree coordinates and heights.

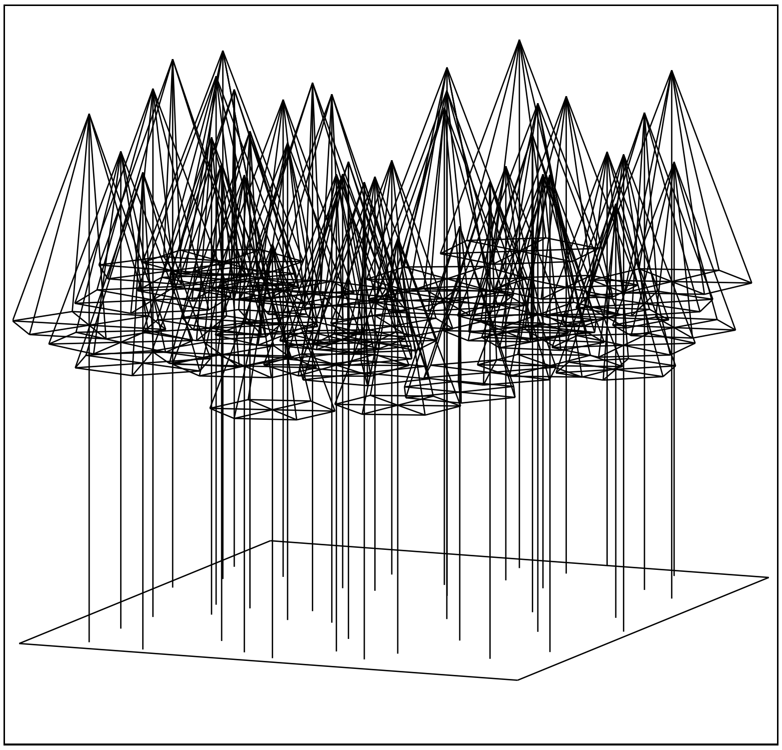
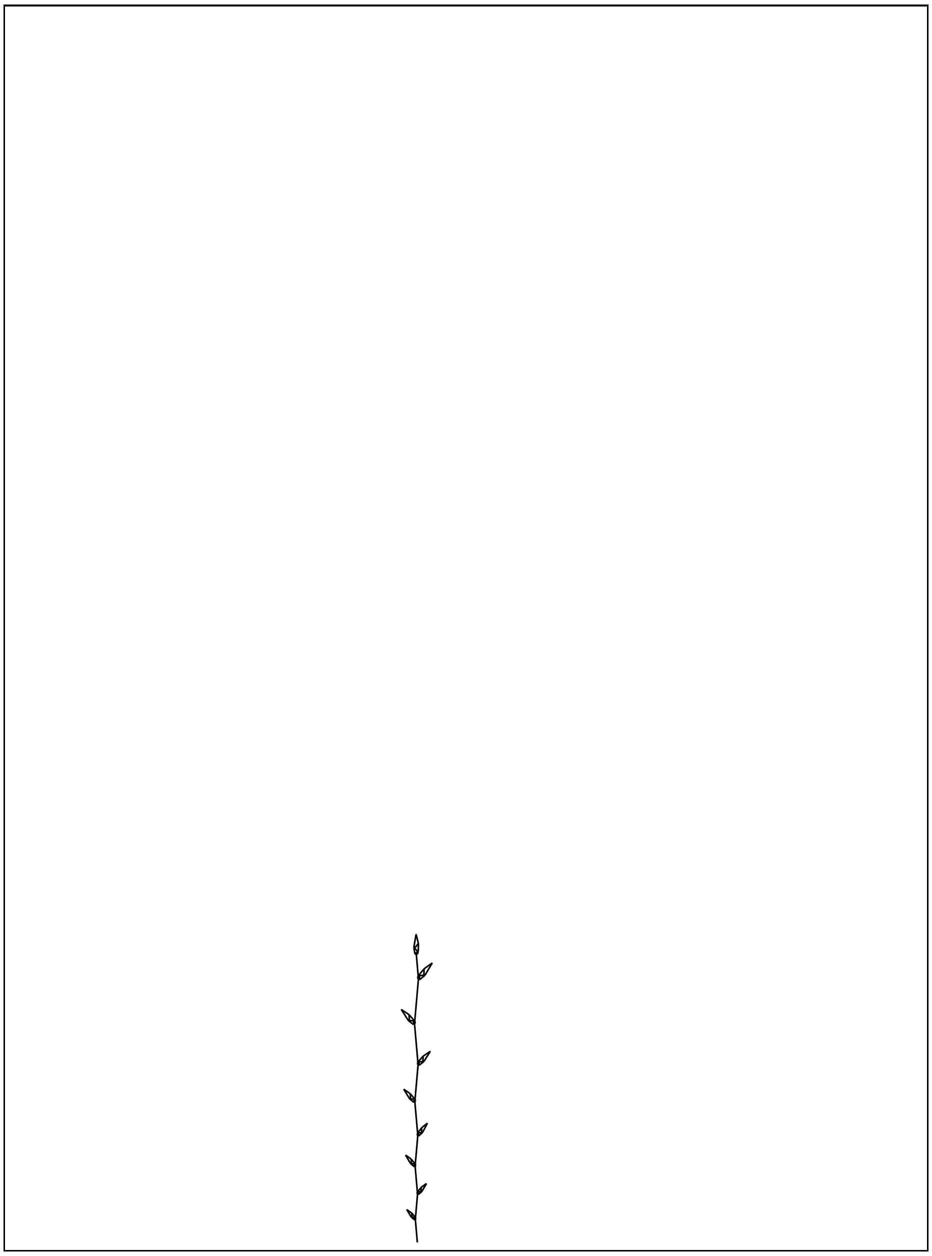
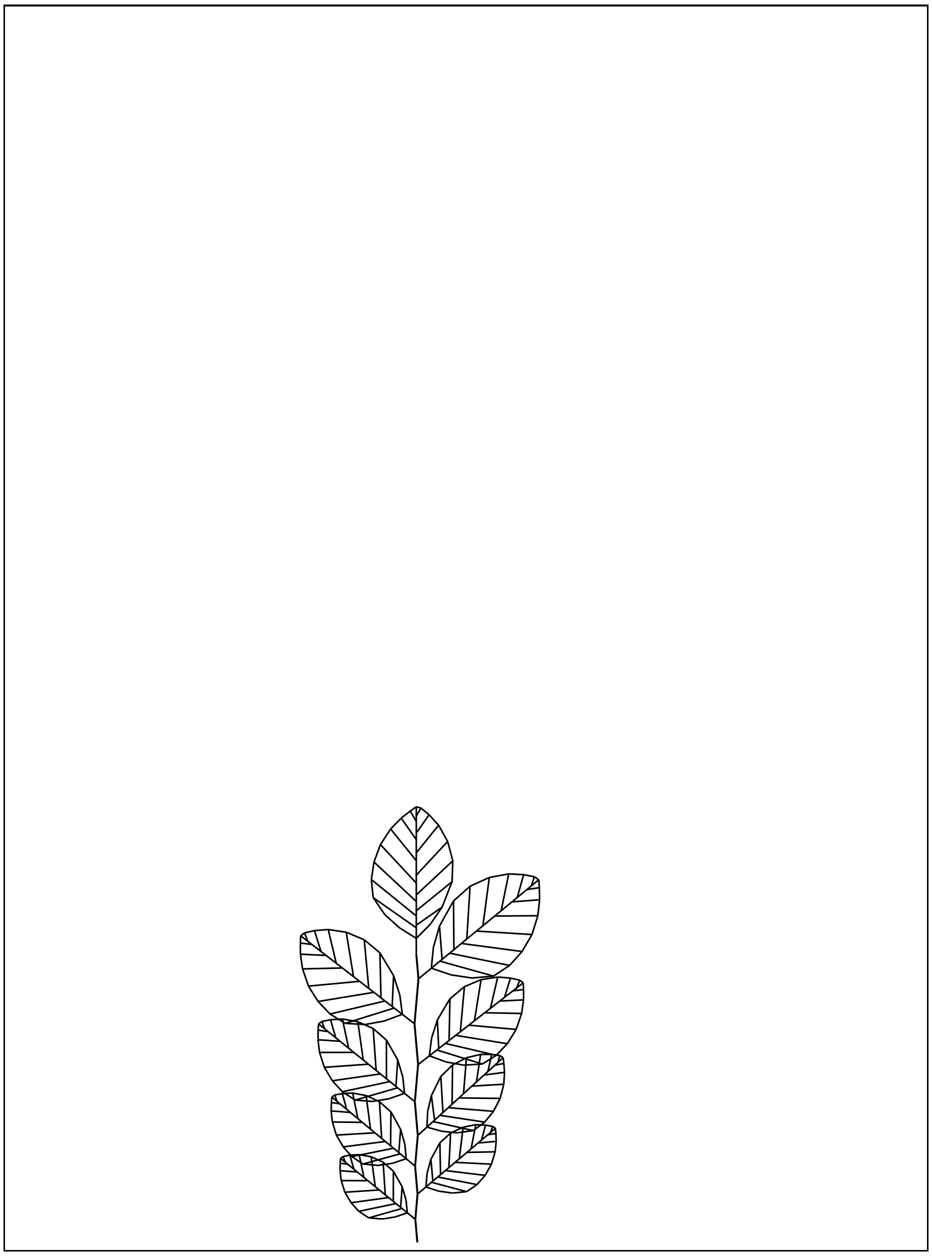


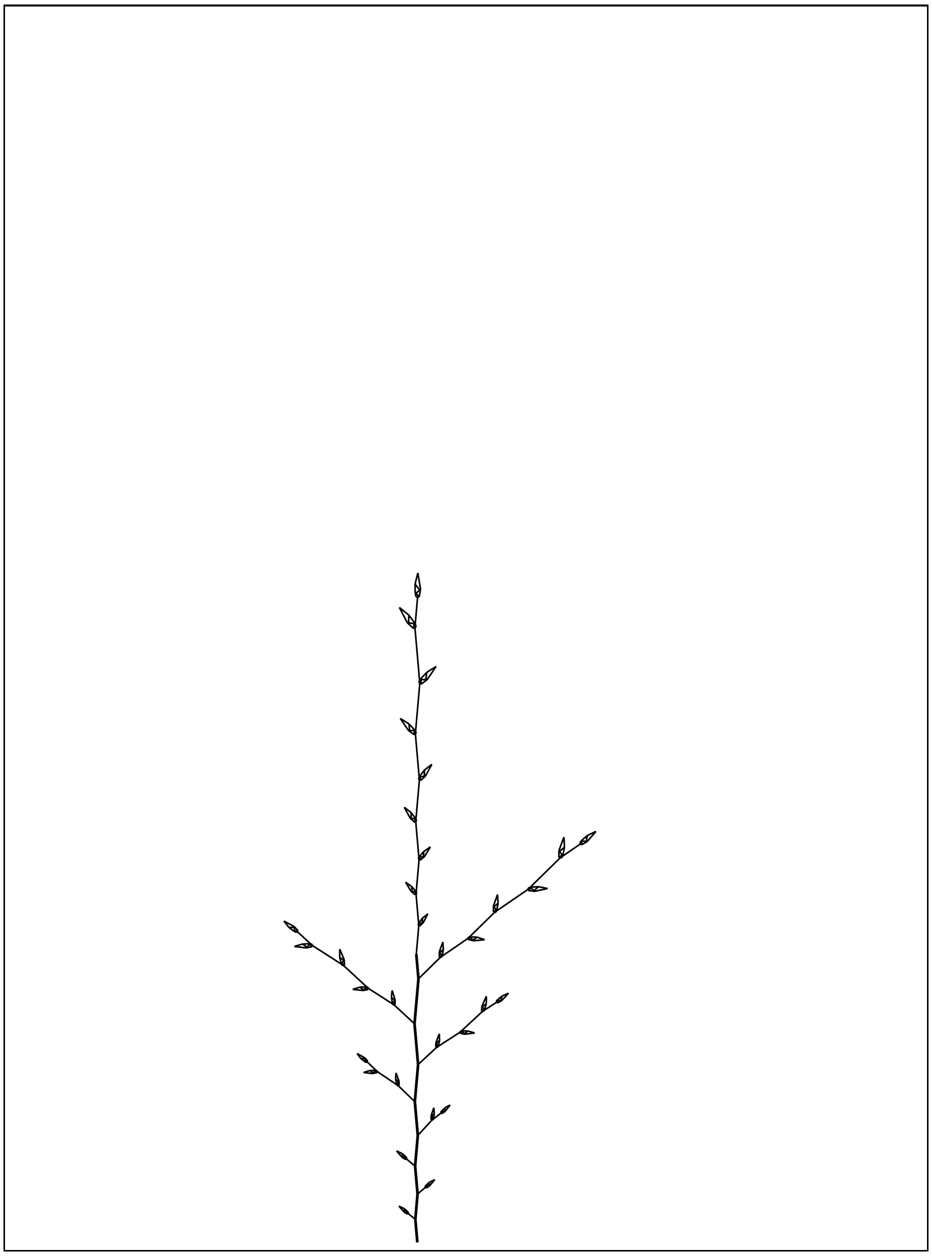
Fig. 10: The same spruce stand as in Fig. 8. Here, a simplified tree description was inserted into the growth grammar instead of the detailed tree model of Fig. 8.



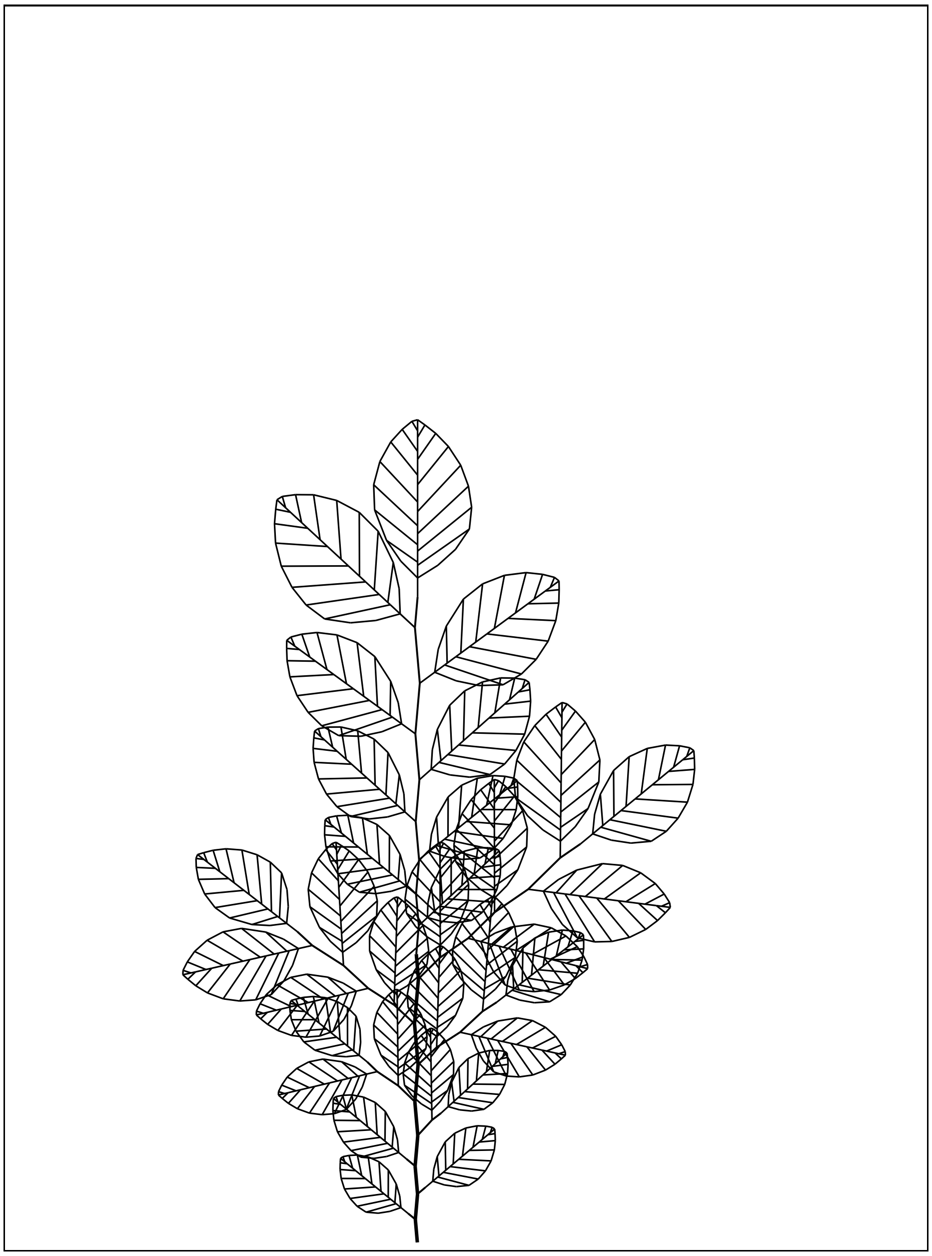
(Part 1 of Figure 6.
This and the following images are no extra figures,
but included only to enable better reproduction of Fig. 6.)



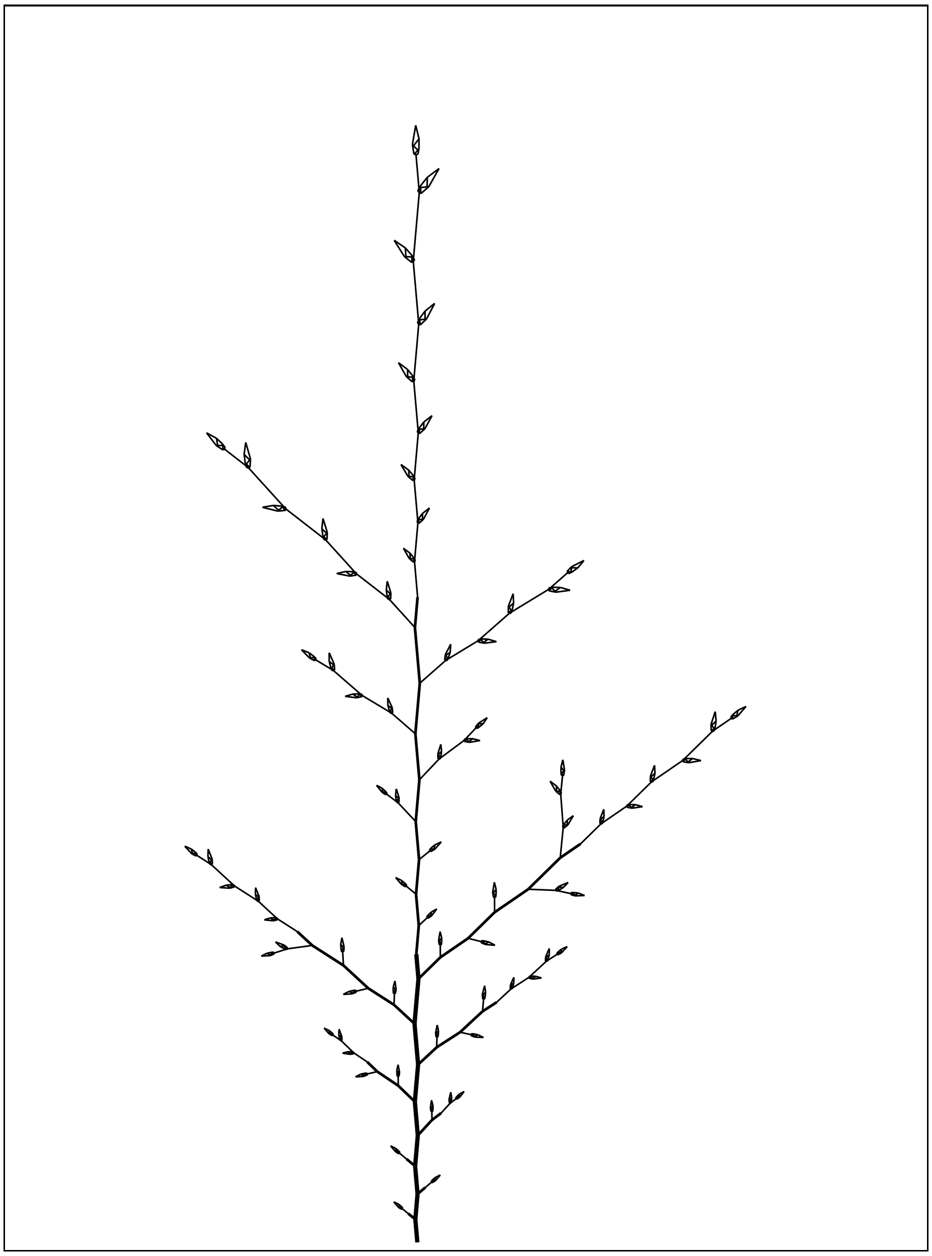
(Part 2 of Figure 6)



(Part 3 of Figure 6)



(Part 4 of Figure 6)



(Part 5 of Figure 6)