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Leaf inclination of *Abies firma* Sieb. et Zucc. responding to light condition

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Many plants transform their leaves in quality and quantity in relation to their environment (Robert *et al*., 1987). Plants have horizontal leaves under low light intensity for efficient photosynthesis, while they have inclined leaves under high light intensity. This paper reports the relations between inclination of leaves of *Abies firma* Sieb. et Zucc. and light condition.

Five Sites in different light conditions were selected on Aobayama Hill in Miyagi Prefecture, Japan. Sites 1, 3 and 4 were set under deciduous trees, Site 2 in a plantation of *Cryptomeria japonica* and Site 5 under the edge of crowns of deciduous trees (Table 1). Several saplings of *A. firma*, 0.7 to 2.3 m high and 27 to 84 years old, were selected at each site and several current shoots located on the outer part of the crown were cut off from each sapling from 23 to 30 September, 1988. The central part of each shoot with about 20 leaves was used as a sample for measurement. The angles of all leaves were measured from the horizon for each sample (Fig. 1). Light intensity was measured by illuminometers at the top of the saplings and simultaneously in open space as a control to obtain relative light intensity (RLI).

Table 1. Relative light intensity (RLI) of the Sites

Site No.	RLI(%) of Sites mean	SD	Number of saplings examined	Situation of Sites
1	0.91	0.25	3	under deciduous trees
2	1.59	0.46	3	under *Cryptomeria japonica* plantation
3	2.71	0.08	3	under deciduous trees
4	3.23	0.24	3	under deciduous trees
5	31.35	12.20	3	under the edge of crown of deciduous trees

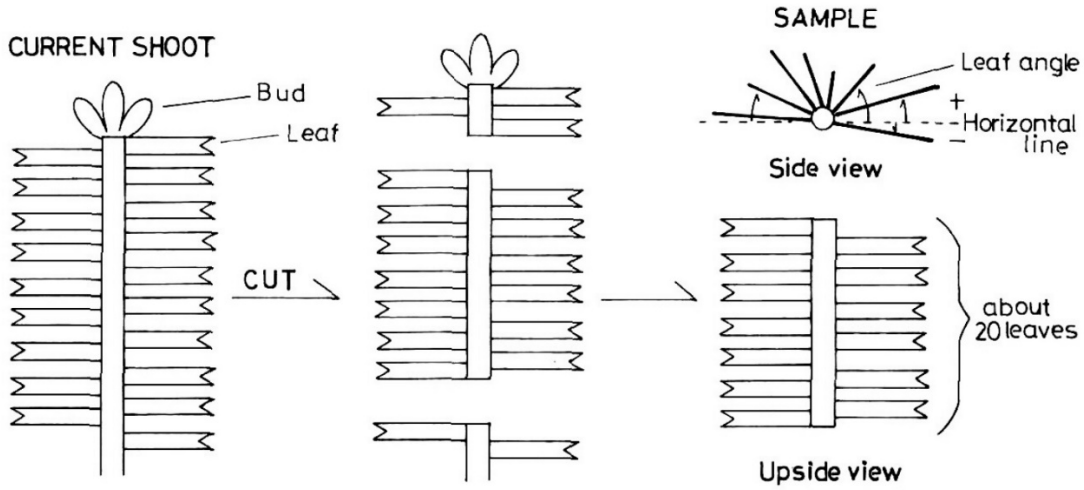

Fig. 1. Procedure of sample treatment and measurement

The shoots had many inclined leaves at Site 5 where mean RLI was as high as 31.35 % (Fig. 2-e). At Sites 1 and 2 where mean RLI were as low as 0.91 % and l .59 % respectively, many leaves were arranged horizontally on the shoots (Fig. 2-a and b). At Sites 3 and 4 where mean RLI were 2.71 % and 3.23 %, respectively, their leaf distributions were intermediate between high light intensity sites (Site 5) and low intensity ones (Sites 1 and 2) (Fig. 2-c, d and Photo 1).

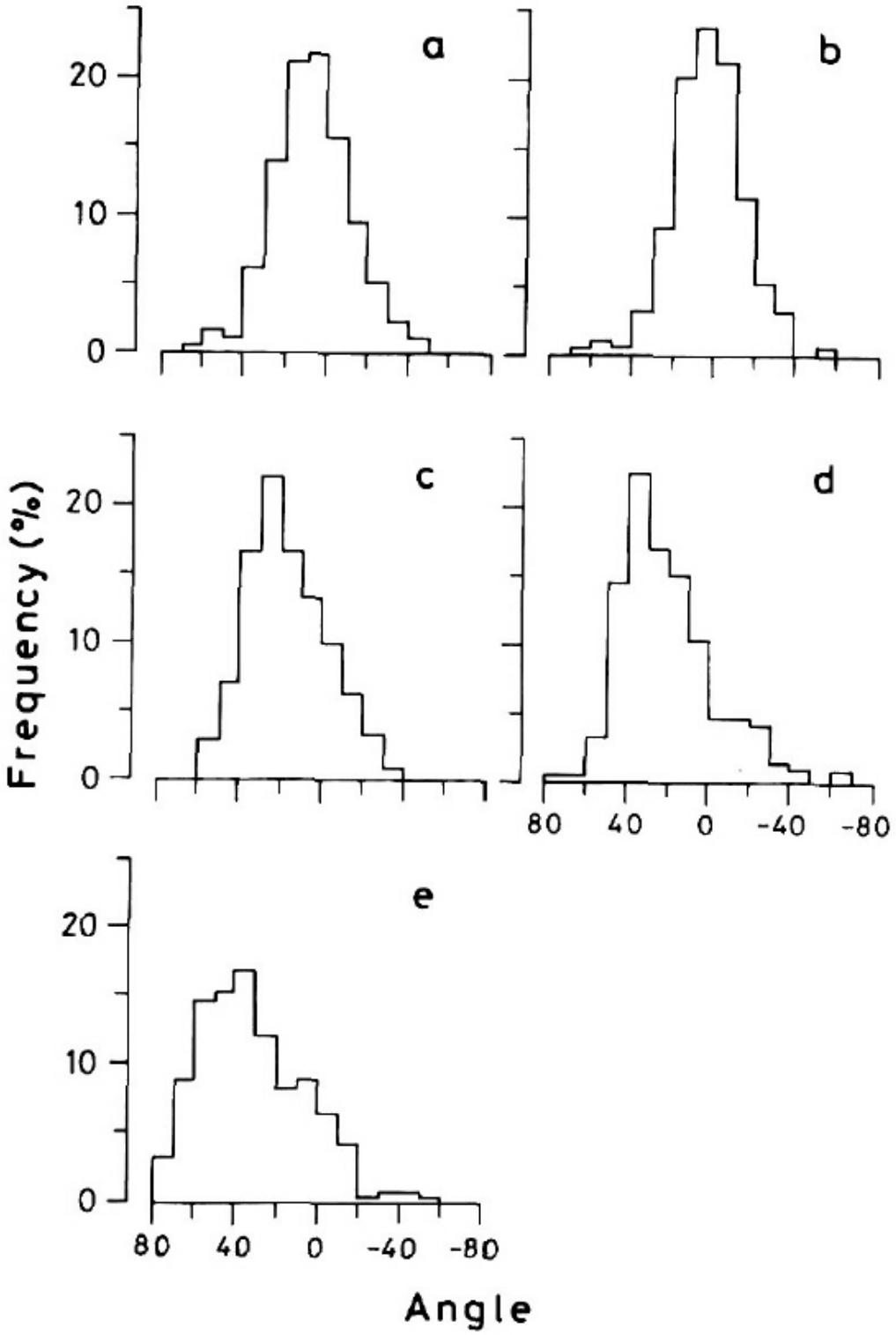

Fig. 2. Distributions of leaf angles from horizon at each site. a: Site 1; b: Site 2; c: Site 3; d: Site 4; e: Site 5.

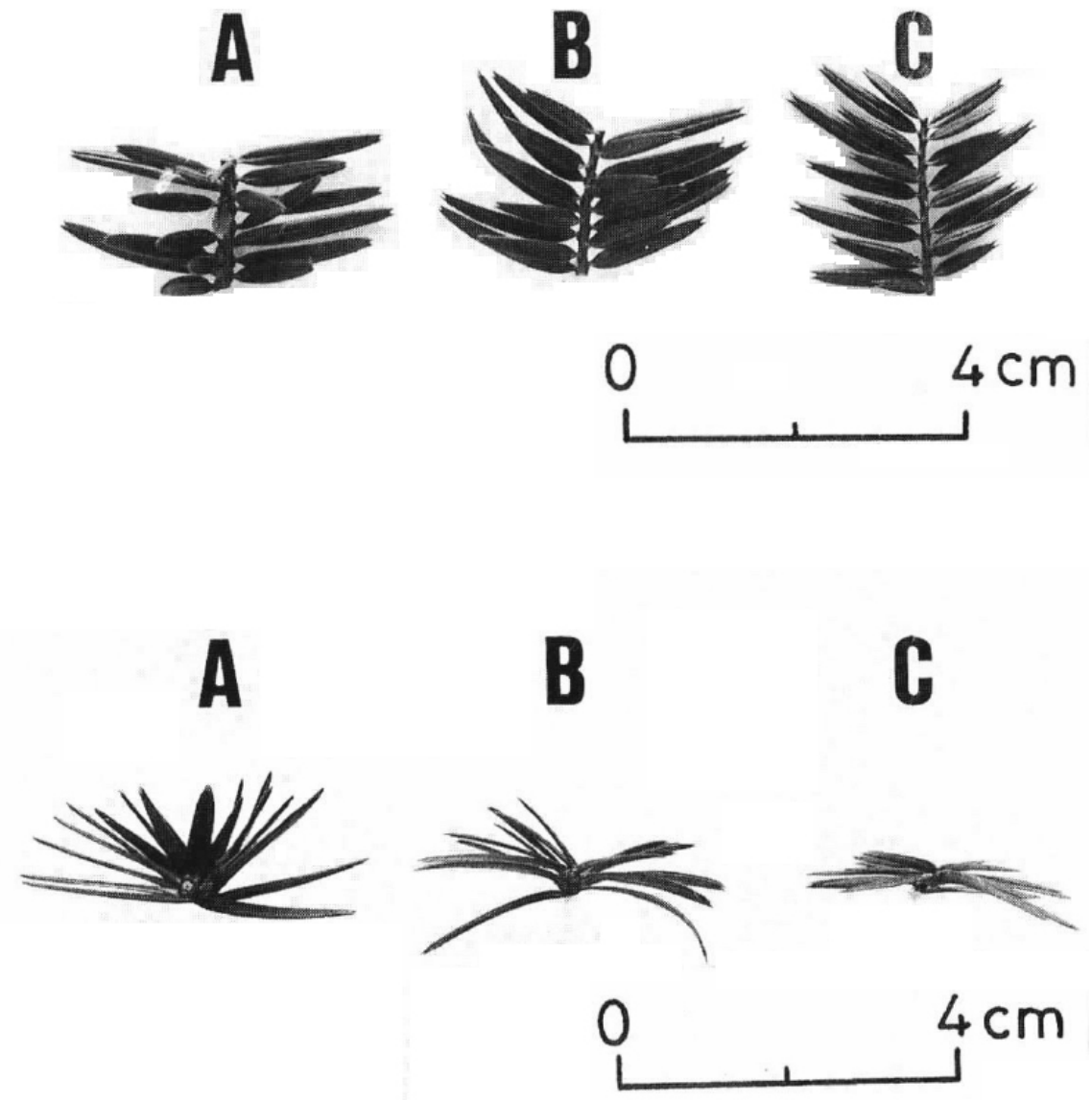

Photo 1. Upside view (upper) and side view (lower) of the samples. RLI of the samples were 31.35 % (A), 3.23 % (B), I.59 % (C).

Fig. 3 shows the mode angles of leaf inclination for individual saplings against RLI of their habitats. The mode angles increased with the increase of RLI as mentioned above. Moreover, the leaf densities on the shoots increased with the increase of RLI as shown in Fig. 4 where numbers of leaves on a unit length were plotted against RLI of the sites. In general, plants with horizontal leaves are adaptive to poor light condition, and those with inclined ones for good light condition (Saeki, 1960).

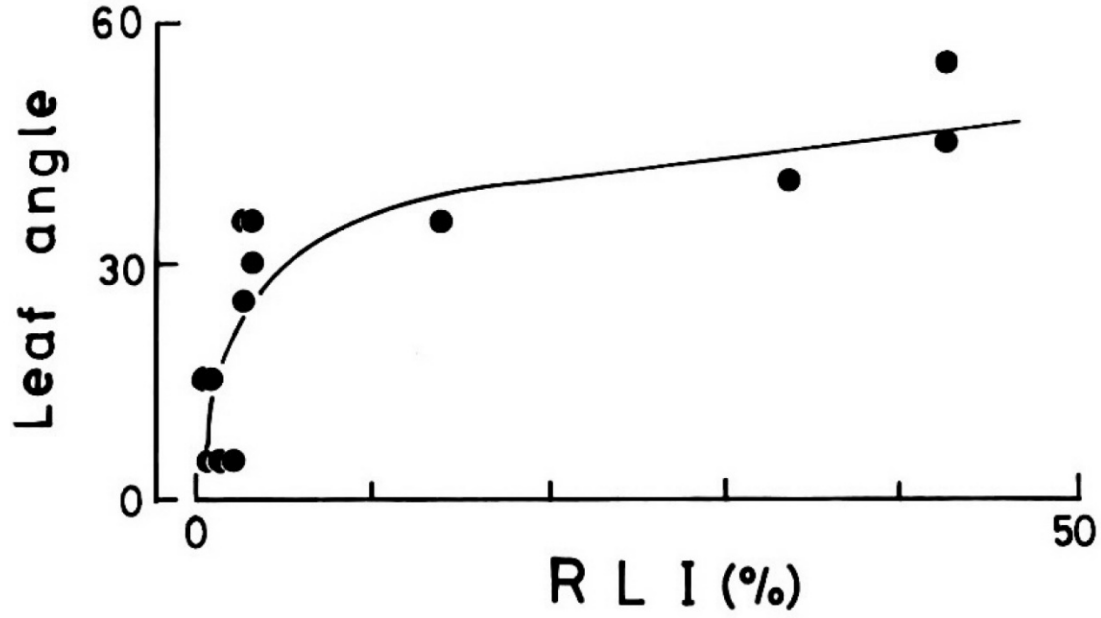

Fig. 3. Relation between mode angles of the leaves from the horizon and RLI at the sites.

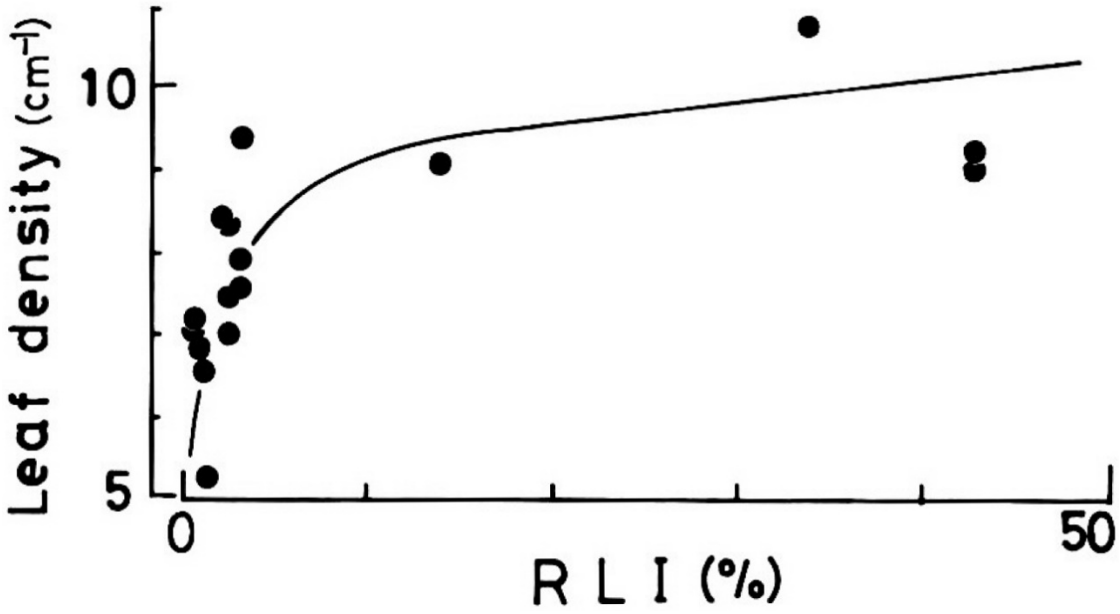

Fig. 4. Relation between leaf density on a shoot and RLI. The density is expressed by number of leaves of the samples per I cm.

Plant maximize their product not only by inclining their leaves under high light intensity but also having denser leaves on their shoots. On the other hand, they have horizontal leaves to get better efficiency under low light intensity. These results support

that *A. firma* have effective leaf formation in response to their light condition. A further important fact was that a drastic change in leaf formation was found under the shaded condition of 0.91 to 3.23 % of RLI (Figs. 3, 4). Seedlings and saplings of *A. firma* grow up under the deciduous trees within a mixed forest (Sugawara, 1978). They have to live under the suppression of deciduous trees before they reach the tree layer. Then, this sensitive transformation of leaves under low RLI will work effectively in the sapling stage.

A. firma leaf formation is so adaptive to light conditions that this feature is advantageous for its survivorship, especially in its sapling stage.

References

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