Past and Recent Progress of the Forest Fertilization in Japan

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In 1920's, Dr. T. Kaburaki emphasized that it will be necessary to adopt the forest fertilization in future forest managements to an extent economically feasible. However, this proposal did not attract any general interest due to the social situation at that time, and as a result the research on forest fertilization showed no progress.

In 1950's, however, a program for increasing forest productivity was developed to dissolve the unbalanced demand and supply of timbers, and the forest tree breeding and forest fertilization were taken up as important research subjects in the silvicultural sector.

Till that time, fertilizers were used only for growing tree seedlings in forest nurseries, and were not applied to forest lands, so that it was not known to what extent the fertilizer response of forest trees can be expected. However, from tests for fertilizer response conducted on young afforested lands, it was made clear that there were cases showing very high fertilizer response. For example, Japanese cedar (*Cryptomeria japonica*) grown by traditional practices without fertilizer application attained about 5–6 m of tree height at the 10th year age even in areas with good site quality, whereas it reached 5–6 m at the 5th year age, and in some cases it reached more than 10 m at the 10th year age with fertilizer application. Forest soil surveys and studies on forest tree nutrition have shown much progress[2,5,7], and which have contributed to the progress of forest fertilization.

The forest fertilization has developed, especially in private forests where an intensive culture is practiced, from the stand point of promoting tree growth and short rotation forests. It spread to more than 90,000 ha in 1970 (Fig. 1), being supported by rapid economic growth of Japan.

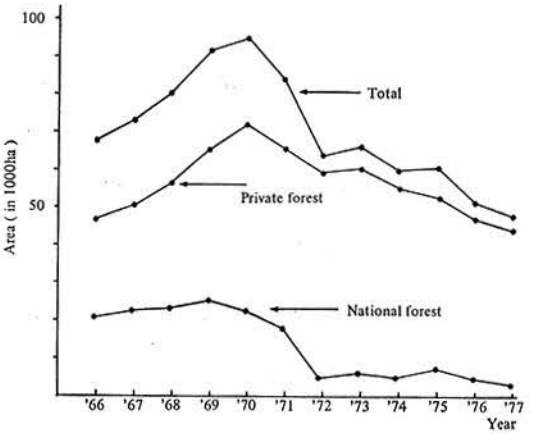

Fig. 1. Yearly trend of forest fertilization area in Japan

However, it was found that in some fertilized forests too much emphasis was placed on the mass production, and the use of excessive quantity of fertilizers caused various damages. In some cases, timbers of poor quality for building use were produced. Thus, the reflection for that was made.

In recent years, the forest fertilization not only aiming at the mass production but also considering the wood quality is proposed, and the fertilization system combined with the tending of forests in their whole life is being developed. The recent spread of forest fertilization area is stagnant at about 50,000–60,000 ha, due to decreasing planting area, rising fertilizer prices and increasing labor wages.

Present status of young forest fertilization[1,4)]

The fertilizer application at the time of tree planting is effective in promoting height growth and foliage growth of trees. Consequently it shortens weeding period, and accelerates the crown closure of forest stands. A guidline for the rate of fertilizer application at the planting time is given in Table 1. It is safe to reduce the rate when seedlings are feeble, or under a long spell of drought. In some cases, the fertilizer application is made in the second year, instead of the planting time, after the survival of seedlings is confirmed.

The fertilizer application is made about three times, either successively in 2–3 years or every other year. The application rate in the second year is 10–20% more than that of the planting time, and the rate in the third year is 10–20% more than that of the second year. As to the fertilizer placement, it is recommended to apply fertilizer into shallow ditches opened at a side of trees, or to broadcast to a circle around each tree, followed by shallow soil covering.

Plantings at proper sites and appropriate fertilizations can reduce weeding terms and hasten the crown closure of forest stands.

Present status of adult forest ferilization

To maintain the soundness of adult forests, the tending, such as removal of vines, pruning and thinning, is practiced. The fertilization is made by keeping a close relation with the tending. Namely, as the tree growth slows down by pruning, the fertilization is made with a purpose of promoting it's recovery and reducing a period required for occlusion after pruning. As the crown closure of forest stands is broken temporarily by the thinning, the fertilization is made to recover it. The fertilization at 10 years prior to the final cutting (at present, it is done at 45–55 years old for Japanese cedar) is made in many cases in expecting an increased volume at the final cutting.

For adult forest fertilization, not only compound fertilizers containing nitrogen, phosphorus and potassium but also straight fertilizers like ammonium sulfate or urea are used. Simple broadcasting of fertilizers is good enough, because fine roots of trees are densely distributed close to the soil surface of adult forests. A common rate of application is 100 kg/ha/year in terms of nitrogen (N). Successive applications in 2–3 years or applications every 1–2 years for 3 times are usual. For large areas, aerial fertilizations (using single-engined planes or helicopters) are employed.

It is observed that the width between an-

Table 1. Application rate of fertilizer at planting time

Species	Fertilizer elements per seedling		
	N (g)	P_2O_5 (g)	K_2O (g)
Japanese cedar (*Cryptomeria japonica*)	8—12	5— 7	5— 7
Japanese cypress (*Chamaecyparis obtusa*)	8—10	5— 6	5— 6
Japanese red pine (*Pinus densiflora*)	6— 8	4— 5	4— 5
Poplar sp.	24—40	16—28	12—34
Ecualyptus sp.	16—32	10—20	8—27
Paulownia sp.	24—48	16—32	12—40
General broad leaves trees	10—14	7— 8	5— 8

nual rings is increased by the fertilization. In Japan, timbers with the width between annual rings of more than 6 mm are regarded to have a problem in their strength as the timber for building. Adult *Cryptomeria* forests with the site quality below the medium level show approximately 1–3 mm/year in the width between annual rings, so that if the width is increased by fertilization to 4–5 mm/year, there is no serious problem in wood quality.

Since the width between annual rings can be regulated by stand densities, it is possible to secure the soundness of forest stands as well as good wood quality by the combination of pruning, thinning and fertilization.

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