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Mixed Planting Test of *Acacia mollissima* and *Eucalyptus rostrata*

Morishige HARADA

I. Introduction

Seeds of *Acacia mollissima* were imported into Japan for the first time from Australia in 1920, and planted for trial with the object of collecting tannin in Japan. Afterward, the Fukuoka Forestry Experimental Station began to test this species and collected seeds from the mother trees at the Station, and sowed, nursed and produced lots of seedlings every year. Those young trees have been planted and grown on a commercial basis all over Kyushu. Amakusa-Gun, Kumamoto Prefecture and Miyada-Town, Fukuoka Prefecture are noted as the largest plantations of *A. mollissima* in Kyushu, and the species has come to be planted widely by large paper manufacturers in Japan of late.

The author planted this species in the Kasuya Experimental Forest attached to the Agricultural Department of Kyushu University in 1956, and reported the growth of *A. mollissima* in the Monthly Reports of the Kyushu University Forests, No. 132, June 1961. In general, *A. mollissima* grows well on sunny lower mountains in Kyushu, but it is vulnerable to the cold and strong wind.

Seeds of *Eucalyptus rostrata* were brought into Japan from Australia far later than those of *E. globulus*, and the former have been planted as single trees in gardens of government offices, schools and parks in the warmer districts of Japan. Later, through the encouragement of test planting of *Eucalyptus* species by the Japanese Forestry Agency over three years, from 1956 to 1958, the forestry experimental station in each prefecture test-planted *E. rostrata*, and the Kasuya Experimental Forest Office planted *E. rostrata* in 1954 and the Fukuoka Forestry Experimental Station in 1955.

The author described the growth of *Eucalyptus* during a year after planting in the Bulletin of the Kyushu University Forests, No. 27, December 1956, and described the growth of *E. rostrata* in the Reports of Kyushu University Forests, No. 11, December 1958. *E. rostrata* trees at each plantation were not damaged by the heat in summer, and though a part of leaves withered owing to the cold in winter, there was no harm to the branches and the stem, and they are growing soundly at present. Since *E. rostrata* is strong against wind, even the typhoons did no damage to it. The less fertile the soil on the mountain, the worse the growth of *E. rostrata*, even under good sunshine.

As *A. mollissima* and *E. rostrata* have such shortcomings as mentioned above in pure forests in Japan, the author conducted this test on the assumption that the shortcomings might be overcome by mixed planting of the two species and successful results might be obtained in the formation of forests.

II. Test Results and Considerations

The test forest was established at Division 9 of the Kasuya Experimental Forest at 91–101 m above the sea level. The hill has a south-eastern aspect with an average

Table I. Growth of *A. mollissima*

Species	Area (ha)	Division	No. of Trees	Planting: March 1956				
				Av. max height (m)	An. growth of Max. height (m)	Av. max. dia. (cm)	An. growth of max. dia. (cm)	Av. max. wood vol. (m ³)
<i>A. mollissima</i> (Mix. Forest)	0.25	I-IV	320	11.60	1.93	14.00	2.33	0.125
<i>E. rostrata</i> (")	"	"	194	10.25	1.71	10.60	1.77	0.058

Table II. Growth of *A. mollissima*

Species	Area (ha)	Division	No. of trees	Planting: March 1957				
				Av. max. height (m)	An. growth of Max. height (m)	Av. max. dia. (cm)	An. growth of max. dia. (cm)	Av. max. wood vol. (m ³)
<i>A. mollissima</i> (Mix. Forest)	0.25	I-IV	59	8.89	1.78	6.50	1.30	0.0147
<i>E. rostrata</i> (Pure Forest)	0.04	—	55	10.00	1.67	11.00	1.83	0.0495

slope of about 20°, and the greater part of the plantation is a sunny plane on the hill-side. The hill is generally of poor soil of various parent materials, mostly mudstone, and the ground is sufficiently moist, though not flooded. The plantation consists of the formerly cultivated land and the uncultivated land. The former is somewhat fertile, but the latter has little humus and consists of poor red clay of 5.5 of acid degree. The plantation is divided into Divisions I-IV by geographical features. One young tree was planted in each 3.3 m².

The growth of *A. mollissima* planted in March 1956 is very good, the average height of tree being 9.58 m, the average diameter 10.74 cm, the average wood volume 0.0579 m³, the annual average growth 1.6 m in height, 1.79 cm in diameter, and 0.0096 m³ in wood volume. The growth of the ones planted in 1957 in the space on the same plantation is far inferior to those planted in 1956, because the former were suppressed under the crowns of the latter. The growth of *A. mollissima* is so vigorous that supplementary planting is not practical.

Some trees were blown down by the typhoon of the largest velocity of 23.5 m in 1958, but none fell in the other years. There were an average of 35 days of frost-fall, an average of 7 days of snow-fall and the lowest average absolute temperature was -4°C in the past six years, but *A. mollissima* was not damaged by the cold. Though the leaves of *E. rostrata* withered in some degree, the branches were not affected by the cold.

According to the results of the test, if the plantation is a relatively low land, *A. mollissima* is not damaged by the cold, even at -4°C. A very few trees of *A. mollissima* (1.6%) fell in the strong wind, because they were supported by many lateral roots of *E. rostrata* planted mixed with the former. The growth of *A. mollissima* is very vigorous on the poor soil, because of a little fertilization at planting and other favorable conditions of the site.

The leaves were eaten by many basket-worms in the third year after planting, but

and *E. rostrata*

Investigation : March 1961							
An. growth of max. wood vol. (m ³)	Av. height (m)	An. growth of height (m)	Average dia. (cm)	An. growth of dia. (cm)	Av. wood vol. (m ³)	An. growth of wood vol. (m ³)	General growing stock (m ³)
0.0210	9.58	1.60	10.74	1.79	0.0579	0.0096	18.5280
0.0097	5.39	0.90	4.41	0.74	0.0075	0.0012	1.1834

and *E. rostrata*

Investigation : March 1961							
An. growth of max. wood vol. (m ³)	Av. height (m)	An. growth of height (m)	Average dia. (cm)	An. growth of dia. (cm)	Av. wood vol. (m ³)	An. growth of wood vol. (m ³)	General growing stock (m ³)
0.0029	6.61	1.32	4.46	0.89	0.0056	0.0011	1.3261
0.0083	4.63	0.77	4.13	0.69	0.0046	0.0008	0.2530

No. of trees : 59 (I-IV) (*Preparation* planting)

the worms vanished entirely of themselves without extermination. On the contrary, the pure forest of *A. mollissima* in the compound of the Kuwara Workshop of the Kasuya Experimental Forest Office has been receiving severe damages by basket-worms every year.

Judging from the above-mentioned facts, the author recognizes that it is effective to mix *E. rostrata* with *A. mollissima* in planting.

The growth of *E. rostrata* planted mixed with *A. mollissima* in March 1956 is far inferior to the growth of the latter, the average height being 5.39 m, the average diameter 4.41 cm, the average wood volume 0.0075 m³, the annual average growth 0.90 m in height, 0.74 cm in diameter, and 0.00125 m³ in wood volume. Such bad growth of *E. rostrata* is due to the fact that they are suppressed under the vigorous crowns of *A. mollissima*. The growth of *E. rostrata* near the edge of the mixed forest is far better than that in the central part of the forest, helped by better sunshine and the function of fungi in the nodules of *A. mollissima*. The largest trees of *E. rostrata* near the edge of the mixed forest (Divisions I-IV) average 10.25 m in height, 10.60 cm in diameter, and 0.0581 m³ in wood volume. The annual growth of the largest tree of *E. rostrata* in each division is 1.71 m in average height, 1.77 cm in average diameter, and 0.0097 m³ in average wood volume.

Table III. Climate

Year	Annual av. temp. (c)	Av. max. temp. (c)	Abs. max. temp. (c)	Av. min. temp. (c)	Abs. min. temp. (c)	Rainfall per yr. (mm)	Snow days per yr.	Frost days per yr.	Max. wind vel. per yr. m/s
1956	15.4	19.8	36.2	11.1	-3.0	2253.5	10	41	20.1
1957	15.4	19.8	35.3	3.3	-4.5	2066.8	4	31	18.5
1958	16.3	20.8	35.1	12.0	-3.0	1642.3	8	31	23.5
1959	17.3	21.7	28.0	12.2	-3.5	1560.0	7	29	16.8
1960	16.1	21.6	27.1	13.6	-4.5	1842.3	11	41	30.2

The pure forest of *E. rostrata* set up next to the mixed plantation has 4.63 m of average height, 4.13 cm of average diameter, and 0.0046 m³ of average wood volume, the annual growth being 0.77 m in average height, 0.69 cm in average diameter, and 0.0008 m³ in average wood volume. The largest tree of *E. rostrata* in the pure forest is 10.00 m in height, 11.00 cm in diameter, and 0.0495 m³ in wood volume, the annual growth being 1.67 m in height, 1.83 cm in diameter, and 0.0083 m³ in wood volume.

Judging from these results, the bad growth of *E. rostrata* in the inside of the mixed forest is due to lack of sunshine and the suppression by the crown of *A. mollissima*, and the growth of *E. rostrata* near the edge of the mixed forest is worse than that of *A. mollissima*, but is better than that in the pure forest of *E. rostrata*. It means that *E. rostrata* near the edge of the mixed forest receives good sunshine and is affected by the nodule fungi of *A. mollissima*. Observing from the general growing stock, the volume of *A. mollissima* is 19.8492 m³ per 0.25 ha, that of *E. rostrata* is 1.1834 m³ per 0.25 ha in the mixed forest, but is 0.2530 m³ per 0.04 ha in the pure forest of *E. rostrata*. From the abovementioned results, the vigorous growth of *A. mollissima* is realized very well in comparison with the growth of *E. rostrata*.

Though the mixing of *A. mollissima* and *E. rostrata* is advisable in the forest formation, care must be exercised regarding the planting density. The stems of *A. mollissima* and *E. rostrata* grow straight by dense planting, but the growth of *E. rostrata* is suppressed by the vigorous crowns of *A. mollissima*. Therefore, the trees of *A. mollissima* should be lopped off or thinned at suitable opportunities, so that sunshine may be led into the forest and *E. rostrata* may be given the normal conditions for growing.

III. Summary

- 1) *A. mollissima* was not damaged by the cold, even at -4°C , while the leaves of *E. rostrata* were damaged in some degree every year in the past six years.
- 2) Though *A. mollissima* has shallow roots, a very few trees (1.6%) were blown down by frequent typhoons. Many lateral roots of *E. rostrata* helped to support them.
- 3) The growth of *A. mollissima* planted in 1956 showed good results (Divisions I-IV), but the growth of those planted in 1957 in the space on the same plantation is far inferior, suppressed under the crowns of the former.
- 4) The leaves of *A. mollissima* were eaten by many basket-worms in the third year after planting, but the worms vanished of themselves without extermination.
- 5) The growth of *E. rostrata* is far inferior to that of *A. mollissima* due to the suppression under the vigorous crowns of *A. mollissima* and lack of sunshine.
- 6) The growth of *E. rostrata* (Divisions I-IV) planted near the edge of the mixed forest is far better than that of *E. rostrata* at the central part of the forest, because of good sunshine and the function of nodule fungi of *A. mollissima*.
- 7) From the above-mentioned results, it is recognized that the mixed planting of *A. mollissima* and *E. rostrata* is effective in the formation of forest, but care must be exercised to control *E. rostrata* by thinning or lopping off branches of *A. mollissima* at suitable opportunities.

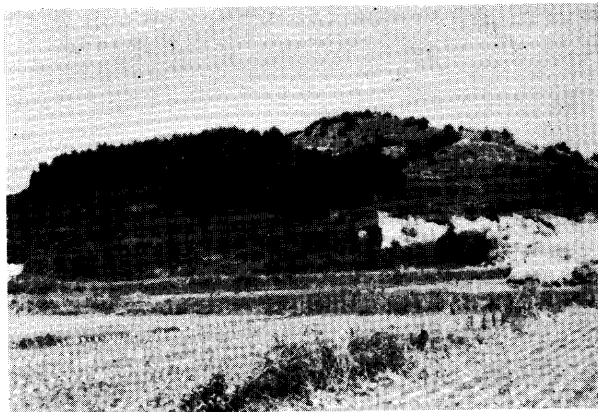


Fig. 1. A distant view of the mixed forest of *A. mollissima* and *E. rostrata*

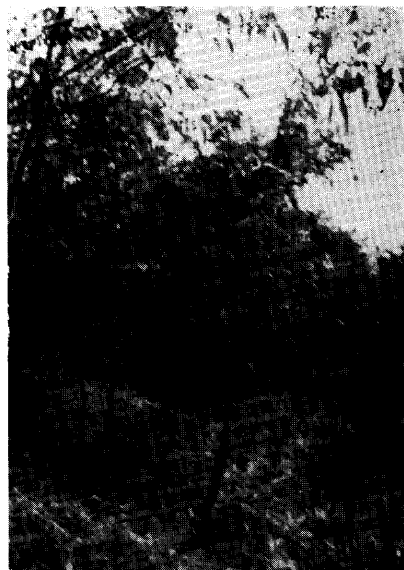


Fig. 2. Pure forest of *E. rostrata*
Planted : March 1957



Fig. 3. *A. mollissima* and *E. rostrata* in the mixed forest
Planted : March 1956
March 1957

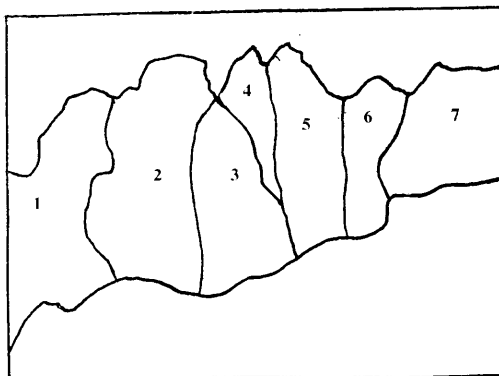


Fig. 4. Sketch of Fig. 3
A. mollissima : 1. 4. 5. 6. 7.
E. rostrata : 2. 3.