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Forest Regeneration Utilizing Mulching Sheet and Mycorrhizal Fungi

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Abstract

In order to investigate the possibility of utilizing a combination of a mulching sheet(MS) composed of Polyester random fiber web as the main material and mycorrhizal fungi(MF), effects of their utilization were surveyed for 2-4 years on the growth of *Pinus thunbergii* Parl. and *P. densiflora* Sieb. et Zucc. at model and actual slopes. At plots where spores of *Pisolithus tinctorius* Coker et Couch f. *tinctorius*(Pt) were dispersed as MF and MS were applied after *P. densiflora* was seeded, the stem diameter at ground level and planting stock height showed greater values from the first year, compared with those at control plots.

The growth at the experimental site belonging to Ehime University where seeds of *P. densiflora* were incorporated into the MS showed greater values of stem diameter at ground level and planting stock height from the first year, compared with those at control plots. MS were stuck at the site where 4 years had elapsed after *P. thunbergii* was planted at Mt. Tanakami in Ohtsu, Shiga. An increase of 66-494% was shown in the stem diameter at ground level and tree height of *P. thunbergii*, compared with those of control plots during 4 years. At the Nojiri River experimental site on Sakurajima Island in Kagoshima where *P. thunbergii* of a two year-old planting stock was planted after MS were stuck, *P. thunbergii* showed a strong tolerance against sulfurous acid gas(SO_2 gas). From these findings, it was estimated that MS and MF were effective for the regeneration of forests devastated by various causes.

Key words: **forest regeneration, mulching sheet, mycorrhizal fungi, seed**

1. Introduction

At present, because of a low grade in the vegetation cover is observed in the early stage, it is necessary to pay careful attention to soil formation as the basis of growth, and the acceleration of the initial growth of trees becomes critical, when forest regeneration is attempted on slopes and devastated land (Ezaki *et al.* 1993).

The authors have developed a mulching sheet(MS) with polyester random fiber web as the main material to solve these problems (Ezaki *et al.* 1993). The influences of this MS on the growth of the vegetation were studied using a mycorrhizal fungi(MF) as a model over 2-4 years on real slopes. In this study, the utilization of MS and MF for forest regeneration was examined.

2. Experiments and Survey Methods

A model experiment was carried out at the College of Agriculture, Ehime University in Matsuyama. The field experiment was carried out at the College of Agriculture, Ehime University and Mt. Tanakami in Ohtsu, Shiga where representative devastated lands are located, and Sakurajima Island in Kagoshima. The experiment was done using a model slope constructed with decomposed granite. Plots including the MS with seeds of *P. thunbergii* and *P. densiflora* and a control was arranged. In these experiments, spores of a MF, Pt, were dispersed on soil surface during seeding. For the field experiment at Ehime University, the MS, including seeds of *P. densiflora*, were put on banked slopes of decomposed granite. At Mt. Tanakami, two plots with 5-6 year old *P. thunbergii* planted on decomposed granite plots with the MS on the entire surface of the basal part of the trees and the other plots of the control were settled as the objective of the study. On Sakurajima Island, the entire experimental plots were covered with the MS and then 2-year-old planting stocks of *P. thunbergii* were planted at the rate of 1 seedling per 1 m^2. The control plots had no MS. When planting, the spores of a Pt were inoculated partly onto the root system of *P. thunbergii*.

3. Results

Changes in the total growth over 3 years for the plots with *P. thunbergii* on the model slope are shown in Fig. 1. Differences in the total growth of *P. thunbergii* in plots with MS compared with the control are 0.1-2.4 mm in the stem diameter at ground level and 1.6-7.3 cm in planting stock heights. Differences in the growth between the MS plotsand the control showed a tendency to increase with the passage of time.

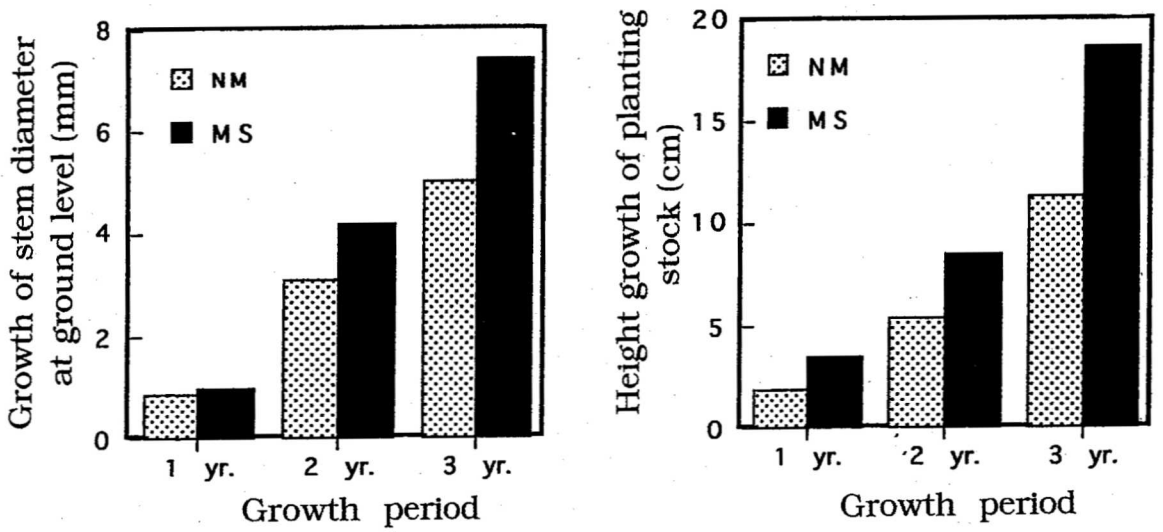

Fig. 1 Changes in the growth of *Pinus thunbergii* on model slopes at Ehime Univ., Matsuyama, Ehime, 1993-95.
NM:no mulch MS:mulching sheet

Changes in the total growth of *P. densiflora* plots are shown in Fig. 2. Differences were found of 0.1-6.9 mm for the stem diameter at ground level, and 2.9-23.4 cm for the planting stock height after one year at the MS+Pt plots compared with the control. Differences in the planting stock heights, root lengths and root volumes between the

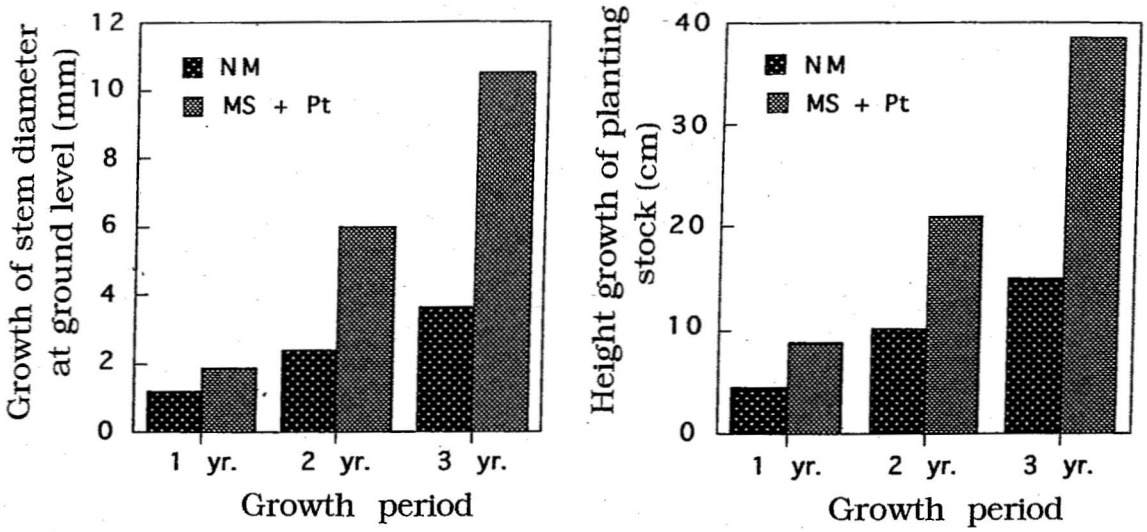

Fig. 2 Changes in the growth of *Pinus densiflora* on model slopes at Ehime Univ., Matsuyama, Ehime, 1993-95.
NM:no mulch MS+Pt:mulching sheet+Pt

P. densiflora infected with a Pt and non-infected ones were found. Total growth of *P. densiflora* in the experimental plots for three years is shown in Fig. 3. Differences in the growth in the examined MS plots with *P. densiflora* are 0.1-1.9 cm in the diameters at ground level and 2.8-5.0 cm in the planting stock heights compared with the control.

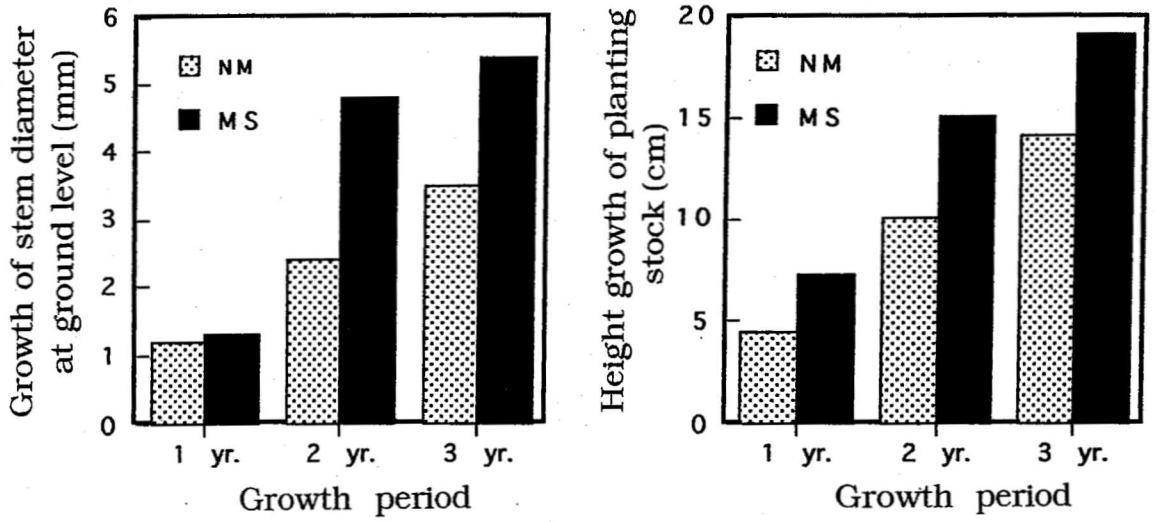

Fig. 3 Changes in the growth of *Pinus densiflora* on actual plots at Ehime Univ., Matsuyama, Ehime, 1993-95.
NM:no mulch MS:mulching sheet

Results obtained at Mt. Tanakami are shown in Fig. 4. Remarkable effects on planting stock heights and diameter at ground level in plot with MS could be recognized comared with control. The maximum values in the diameter at ground level growth were found during the 2nd year with a tendency towards decreasing seen during the 3rd year. The maximum growth in height was recorded during the 3rd year that was the next year of the maximum value in the diameter at ground level. Remarkable growth in the plots with MS at Mt. Sakurajima test plots could be seen compared with the control.

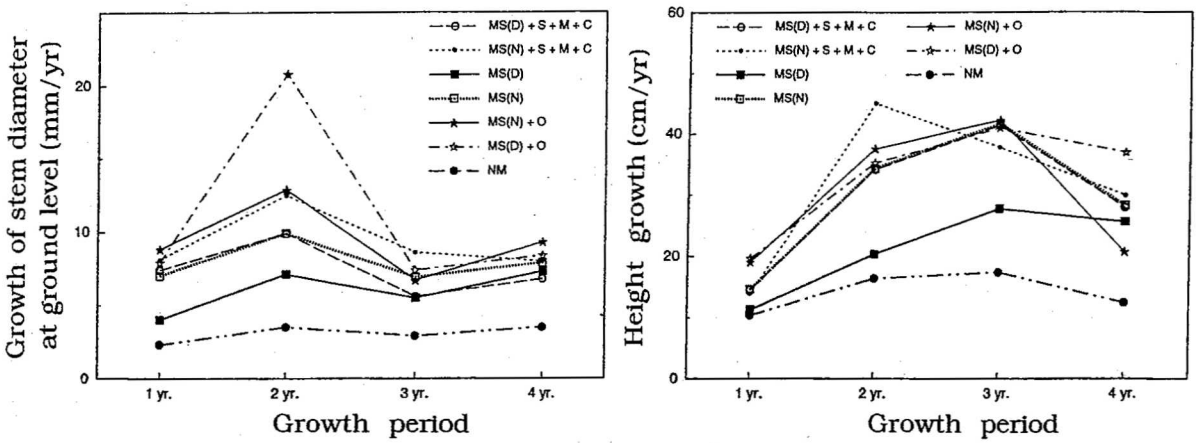

Fig. 4 Changes in the growth of *Pinus thunbergii* at Mt. Tanakami, Ohtsu, Shiga, 1992-95.
MS:mulching sheet D:decomposition S:soil C:dust coal
NM:no mulch N:non-decomposition M:manure O:organic matter
The S, C, M and O were dispersed on the soil surface

The number of dead trees at the end of the 1st year was 19, 6 in plots with MS(rates of death, 3.4%), and 13 in the control with no MS(rates of death, 18.3%), from the total 246 trees planted. The cause of death of the trees was sulfurous acid gas (SO_2 gas), judging from location, state and condition of the coppice shoots after planting. The rates of deathduring the 2nd year were 17.9% in the plots with MS and 32.0 % in the control. Those differences originated from the tolerance in *P. densiflora* evidenced by the partial death of the leaves and twigs affected by SO_2 gas, while the whole bodies of pinetrees in the control plots were influenced by SO_2 gas. The remarkable effects of MS and Pt were found in the test plots, as described above.

4. Discussion

It was presumed that acceleration of tree growth by applying MS and Pt accelerated soil formation in the subsoil for the growth base indirectly and also the acceleration of the growth of the root system. In addition, by applying the MS, the prevention of the sheet erosion was presumed to be one of the causes for accelerating tree growth at these plots. For the reasons mentioned above, it was presumed that the MS might act as an A_0 horizon at the forest soil and the function itself may be similar to the A_0 horizon.

5. Conclusion

The combination of the MS and Pt is an effective way to solve the problems of attempting forest regeneration with the planting of trees on slopes and devastated land and the authors suppose that this method is probably the best.

References

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