The Application of the Biological Science to the Problem of Growing Timber Crops.

By

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At present, various problems of applying the biological science to the forestry are being discussed by some scholars in Japan, and there are many results of these studies and their application in the handling of forestry; for instance, on the ecological studies or sylvicultural characteristics of forest trees, acclimatization or adaptation of tree species, dendrology, spermology, soils, manures and so on.

Here, I will select either articles of general interest to the public or those of special value to the practical forestry and summarize briefly as under.

The particulars, however, may be known by respective individual papers.

I. Plant Indicators Relating to Silviculture in Japan. By Masaru Kawada.

In view of the general tendency, it is true that any sylvicultural treatments on the given forest, should be based upon the ecological investigations. From this point of view, Mr. M. Kawada, ecologist in the Forestry Experiment Station has carried out an intensive survey on the forest vegetation of Japan, and the result was recently reported in detail under above heading.

The data in his paper justify the conclusion that the character of the native forest vegetation can be used as a reliable indicator of the condition of the forests. He summarised as follows:—

From the standpoint of recognizing woodland as vegetation, the vegetation survey for state forest is now progressed since 1928. Under the present state of this survey the following great divisions of forest vegetation can be acknowledged:

I. Regions dominated by cold xerophytic coniferous forest formations, II. Regions dominated by high mountain xerophytic coniferous forest formations, III. Regions dominated by summer green mesophytic forest formations mixed with deciduous broad-leaved trees and coniferous trees, IV. Regions dominated by evergreen mesophytic forest formations mixed with evergreen broad-leaved trees and coniferous trees, V. Regions dominated by temperate rain forest formations, VI. Regions dominated by coast sand-dune forest formations, VII. Regions dominated by subtropical oceanic forest formations.

Although, there are not so many examples of plant indicators regarding to silviculture, several species can be recognized.

Climatic Indicators.

Trees—the following species, i. e. *Abies Mayriana* Miyabe et Kudo, *Picea jezoensis* Carr., etc. in the region I, *Abies Mariesii* Mast., *A. Veitchii* Lindl., etc. in the region II, *Fagus crenata* Blume., *Quercus crispula* Blume., in the region III. *Tsuga Sieboldii* Carr., *Shiia Sieboldii* Makino, in the region IV, *Machilus Thunbergii* Sieb. et Zucc., *Podocarpus nagi* Pilg., etc. in the region V, *Pinus Thunbergii* Parl. in the region VI, *Calophyllum Inophyllum* L., *Livistonia Chinensis* R. Br., etc. in the region VII are the typical species.

Climbers—*Parthenocissus Thunbergii* Nakai, *Berchemia racemosa* Sieb. et Zucc., etc. in the region III, *Uncaria rhynchophylla* Miq., *Anodendron laeve* Maxim., etc. in the region V, are the typical species.

Epiphytes, and pseudo-epiphytes—*Usnea longisima* Ach., in the region I and II, *Cyclophorus linearifolius* C. Chr., *Polypodium annuifrons* Makino, etc. in the region III, *Bulbophyllum Drymoglossum* Maxim., *B. inconspicum* Maxim. in the region IV, *Aerides japonicum* Reichb. f. *Aspleanium Nidus* L. etc. in the region V, are the typical species.

Autonomous land plants—*Cacalia auriculata* DC. var. *kamtschatica* Koidz., *Dryopteris setosa* Kudo. etc. in the region I, *Eupatrium sachallinense* Makino, *Lysichiton camtschatense* Schott., *Phyllitis scolopendrium* Newm., etc. in the region I, II, and III. *Cacalia palmata* Makino, *Rodgersia podophylla* A. Gray. etc. in the region III, *Plagiogyria eruphlebia* Mett., etc. in the region IV, *Ligularia tussilaginea* Makino, *Phajus maclatus* Lindl., *Angiopteris suboppositifolia* de Vris, etc. in the region V, are the typical species.

Edaphic Indicators.

There are only few examples of forest vegetation obviously affected by edaphic condition on account of the great rainfall and very heavy showers in Japan, *Fraxinus* species for the limestone region, *Quercus* species for Gneiss region in Hondo, *Camptosorus sibiricus* Rupr. as the very keen indicator of limestone, *Corylopsis spicata* Sieb. et Zucc. for surpentine rocks are the remarkable examples.

Indicators of PH values of soils—Relatively high value of PH (5.5-6.0): *Impatiens Textori* Miq., *Polygonum sagittatum* L. var. *americanum* Meisn. f. *Sieboldi* Makino etc., intermediate value of PH (5.0-5.5): *Pirola japonia* Sieb., *Carex lanceolata* Boot. etc., relatively low value of PH (4.5-5.0): *Salvia nipponica* Miq., *Chloranthus serratus* Roem. et Sch., etc.

Seral Indicators.

The species of autonomous land plants described previously as climatic indicators correspond mostly with the indicators of stabilized stage of plant succession. In addition, *Asperula odorata* L. in the regions I, II, and III, *Ilex rugosa* Fr. Schm. and *Oxalis Acetosella* L. var. *japonica* Makino in the region III, *Ainsliaea apiculata* Sch. Bip., *Aucuba japonica* Thunb., *Urtica Thunbergiana* Sieb. et Zucc., *Calanthe discolor* Lindl. and *Oplismenus undulatifolius* Beauv. var. *japonica* Koidz. in the regions III and IV, are known as indicators of the most mesic condition. *Indigofera pseupotinctoria* Matsum. etc. for *Pinus Thunbergii* Parl., *Disporum smilacinus* A. Gray for *Abies firma* Sieb. et Zucc., dwarfed forms of *Hydrangea scandens* Maxim., seedlings of *Vibrunum furcatum* Blume. etc. for *Cryptomeria japonica* Don., *Clintonia udensis* Trautv. et May. for *Thujopsis dolabrata* Sieb. et Zucc. var. *Hondai* Makino are the remarkable good associator for the invasion of seedlings of each tree.

II. A Study on the Rejuvenation of the Pine Forest. By Kin-ichi Morikawa.

Towards the east of the Yashima in Kagawa-Ken, Shikoku, a long range of hills 71 m. above the sea-level, stretches into the inland sea of Seto. This portion of land is a natural pine forest composed for the most part of *Pinus Thunbergii* Parl. and fewer *Pinus densiflora* Sieb. et Zucc.

The site condition was extremely bad; mother rock expose here and there, the soil was thin and dry with scanty litter of fallen leaves and twigs on account of being subject to the direct light and wind.

In spite of their being more than 66-100 years old, these natural pine trees, therefore, shrank into shrub-like dwarfs, almost ceased their growth and were dying.

In March, 1904, the authorities planned a relief measure for this forest by mix-plantation of Hageshibari (*Alnus firma* Sieb. et Zucc. var. *multinervis* Rgl.) and strictly prohibited the removal of fallen leaves and twigs in the area.

Consequently, hitherto shrub-like stunted old pine trees have rapidly increased their growth and formed a thriving forest of large trees. This remarkable phenomenon has been widely spoken of as the rejuvenation of pine trees. Since then in many regions in Japan, profitable effects on the rejuvenation of pine trees by mix-planting of Hageshibari in stunted pine forests.

As it is very important for the growth problem of timber crops to know the cause of rejuvenation of old pine trees brought about by the mix-plantation of Hageshibari, the author endeavoured to clear it up by the biological comparative studies between the rejuvenized area in which splendid growth of pine trees was brought about by mix-plantation of Hageshibari and the adjoining pure pine stand in which the trees are shrub-like as before.

The available water of soil was greatly increased in the growing season of summer in the former. Moreover as the soil moisture in the older state of the forest was so much nearer to the unavailable water that the fact that the available water thus highly increased would be greatly effective to the rejuvenation of the growth.

The water content of pine leaves in the growing summer season was only 97.55% to dry weight of leaves in the latter case and so much as 103.91% in the former. This is the necessary consequence of increase water content of the soil in the former.

The content of starch in pine leaves was much higher in Hageshibari mixed area than in the other.

The total content of organic substance in the soil was average 3.381 % in the former and 1.927 % in the latter. The content of nitrogen in each soil was average 0.1287 % and 0.0825 % respectively.

The rejuvenized pine leaves contain two times as much nitrogen as pine leaves in the latter. The content of nitrogen of Hageshibari leaves mixed in the pine forest coincided with more than two times that of rejuvenized pine leaves and more than four times that of unrejuvenized ones.

On the ground that the content of nitrogen in leaves and root nodules of Hageshibari is remarkably high and nodule forming micro-organism belongs to one of *Actinomycetes* species the author is inclined to presume the nodule forming bacteria to be capable of assimilating the free nitrogen in the air.

The content of ash in the leaves of rejuvenized pine trees was average 1.896 % and 1.998 % in the other case. Consequently, the effects of the mix-plantation of Hageshibari in taking the mineral salts are not considered to be serious for pine trees.

In short, all broad-leaved trees are not able to be successfully mixed as we like in such drier barren soil on which even the growth of pine trees is difficult. The rejuvenation of pine trees, therefore, is to be expected merely by the mixture of special sort of trees like Hageshibari.

The beneficial effects of mix-plantation of Hageshibari are chiefly ascribed to shading forest floor by the thickened canopy in the growing summer season, increasing the moisture and micro-organisms in soil, promoting the carbon-dioxide assimilation, on the other hand increasing the amount of nitrogen in pine trees relatively to the abundance of carbohydrate that the carbo-nitrogen ratio in pine trees to be favourable to the growth of vegetative organs like trunk, branches, and leaves will be led.

III. Plant Succession in Relation to the Natural Grass-Lands Management in Japan.

By Motoo Obseko.

In order to observe the principles of succession on the building up as well as in the deterioration and the course and rate of development of vegetation on the natural grasslands in Japan, special studies were conducted on the National Grass-lands of the Takahagi Branch Station, Forest Experiment Station in Ibaraki Prefecture.

After a careful observation of the vegetation, four major grass-types were recognized, i. e. Miscanthus type (Climax type.) Imperata type (Second grass type.), Zoysia type (First grass type.) and Waste type (Transitional type.) and we reached to the following conclusion.

When the natural grass-lands were managed too irrationally, namely, over-grazing, over-clipping or frequent burning both the grass and soil phases will change gradually to the bad condition, and the order of the successional stage would become Miscanthus, Imperata, Zoysia and Waste as previously mentioned and successional period of respective stage will be long or short according to intensive or extensive treatments.

The fertility of the soil is high in the climax and low in the waste stage.

On the contrary, when the natural grass-lands were left alone, the proper shrubs (habitual species) grow out rapidly and it will finally be converted into the forest once passing through the bushy stage.

Both the Miscanthus and Imperata stages should be managed rationally and also used as long as possible, for these are only the utilizable stages as grass-lands.

Some improvement methods, such as manuring, irrigation, fallowing etc. may, therefore, be applied in these stages.

Those stages below Zoysia are not worthy of utilization and if they once changed into an inferior stage, they would be rather difficult to return to the former conditions. Under such circumstances, therefore, the soil can be made fertile by means of the afforestation and then we shall be able to use them as good grass-lands.