Forest Tree Improvement Research in the Philippines

by

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INTRODUCTION

Unquestionably, the forest resources of the Philippines benefit the people in terms of tangible and intangible values. Indeed, the forests play an important role in the economy of the nation; it being the second ranking dollar-earner among the natural resources. However, the rapid and unwise exploitation of our God-given forest heritage is now gaining an uncontrollable momentum creating an imbalance between production and utilization. Shifting agriculture and other destructive agencies have compounded the forest problem. These are now evidenced by the existence of critical watershed areas which have been rendered treeless and illegally encroached by squatters. Noticeably observable in the forest regions are predominantly second growth forests that are now questionably left as the only potential source of timber. Day by day the best and finest timbers are extracted in the various logging operations. Several thousand board feet of logs have been brought out of the country to supply foreign wood-using industries. This unfortunately has been draining much of the timber supply that the Philippines is now becoming ridiculous of its prestige as beneficiary of such finest and inexhaustible tropical hardwood forest. All these contributing factors have amplified the insecurity problem of the wood using industries and perhaps not a few decades from now the second growth timber stocks would not even suffice our local consumption.

With the present rate of reckless cutting of timber and the apathetic attitude of those involved in forest destruction, there has been a trend of ever-decreasing timber supply in the country. Besides, the timber that are extractable from the second growth forests and in some of the forest plantations have been degrading tremendously in wood quality due to the cumulative effects of undesirable hereditary characteristics and adverse environmental factors. Timber improvement with the application of silvicultural and management practices is not sufficient to eradicate the mechanical injuries, pests and diseases, and other inherent elements that give rise to inferior tree qualities. Oftentimes, such trees are slow-growing, limby, with crooked or forky bole, which render them not potentially of commercial value.

The future of forestry in the Philippines is, however, not yet entirely doomed that hope should be totally shattered. The problem is still not very serious although it would become critical if it remains unchecked. Corrective attitude of those who deal directly on forest production must be developed to create and save the valuable forest for the stabilization of the Philippine economy. Forest tree improvement research should be planned and carried out now for the benefit of the logging business in particular and the public in general. Otherwise, the procrastination of this long-range activity would only yield an unsatisfactory result.

In order to have a systematic program and a better coordination of activities, the forestry agencies should go hand in hand in carrying out the different phases of the research program. It is, therefore, the object of this paper to present and discuss some

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of the pertinent aspects of forest tree improvement in order to know the research areas which should be given top priority. The genetic aspect would be discussed considerably since a greater percentage of the tree improvement process is based on sound genetic principles. Many tree characteristics are also inherently controlled. The research program would endeavor to produce hybrids of desirable characteristics to be able to raise commercial stocks that are genetically fast-growing and of high-quality wood products. This could possibly be attained through proper selection and hybridization of extraordinarily superior trees that are free of diseases and of wide adaptability to adverse environmental conditions. The research materials which could be accumulated together with the improved varieties or species would eventually serve as the future foundation of scientific knowledge in the field of forest genetics and tree breeding in the Philippines.

Discussion

In order to attain the objectives of the tree improvement program a scientific knowledge on the principles of genetics, plant breeding, cytology, silviculture, physiology and pathology should be possessed by the technical men to carry on the activities. Unfortunately, this poses a problem due to the dearth of forest geneticists, cytologists, and tree breeders in the country. However, there are still lots of possibilities to remedy the situation, as discussed elsewhere in this paper.

The scientific approaches in tree improvement research are suggested as follows: (1) genetic approach; and (2) silvicultural approach. Of these approaches, the former is urgently needed in Philippine forestry; hence, several proposals are hereunder discussed for consideration and action.

The Genetic Approach

This approach involves the following: selection of plus trees; introduction of exotic species; clonal multiplication of superior trees; establishment of seed orchards; cytologic and cytogenetic research; provenance studies; and forest tree breeding research. All these activities converges to the production of certified seeds of genetic superiority for commercial tree planting.

Selection of Plus Trees. — In order to determine the desirable as well as the undesirable tree characteristics, such as those of the benguet pine, mahogany, narra, molave, acle, and the dipterocarps, a progeny test which simultaneously includes inheritance studies should be conducted. Seeds of the promising trees are separately collected, sown, grown, transplanted, and finally established in a given site. The rate of growth, form of the bole, mode of branching, and other inherent characteristics are then taken to be able to establish the criteria for the selection of mother trees. In this process, the plus or superior trees could be pinpointed as sources of seeds for planting in the interim that seed orchards are not yet available. Unluckily this method has not been employed by those concerned in the selection of mother trees to supply the seed demand of the reforestation projects. One great opportunity which was missed in this respect is that of the elite parental stock of benguet pine in Bukidnon and Cebu which should have been preserved as seed sources for today's forest planting. The pioneers of these projects must have been very repentant of such irretrievable loss.

Introduction of Exotic Species. — Meanwhile, the desirable species from foreign countries that could easily acclimatize in the different forest regions should be introduced, such as the strikingly fast-growing *Gmelina arborea* Roxb. Other exotic species or hybrids possessing exemplary characteristics should also be preserved and multiplied to supplement the important endemic tree species. These could be utilized as possible sources of valuable germplasms, which are of great value in forest tree breeding.

Clonal Multiplication of Superior Trees. —Many plus or superior trees could be found in the various plantations as well as in the virgin forest. However, very little effort has been exerted on the asexual propagation of the elite seed trees with the ultimate objective of accumulating them in a given site for inheritance analyses. In cases where marcotting, grafting, cutting, or layering have been done, no specific pedigree record as to the sources of the scion or stock is taken. Consequently, no effective research are conducted to evaluate their performance in terms of qualities and potentialities.

Observation on the rooting of *Albizzia falcata* (L.) Back, and the dipterocarps revealed no significant result. This indicates the need of exploiting the possibility of using some rooting media such as rootone, indoleacetic acid, indolebutyric acid, naphthaleneacetic acid and other root-inducing chemicals. Otherwise, the various methods of vegetative reproduction such as grafting, layering and budding should be availed of to preserve the elite mother trees that are found in the plantations as well as in the virgin forests. For example, in Basilan where rubber trees are found very promising, budding should be intensified. Budwoods of superior quality should be obtained at all costs and asexually multiplied for future use. In the reforestation projects, the practice of using wildlings should be discouraged. Instead, the better varieties or high latex yield should be acquired and used in forest planting. The established plantations of the U.P. Land Grant and the Menzi Corporation could be a model to pattern our reforestation plan. Should the existing practice continue it is anticipated that the derivable product would be of unreasonable economic return due to inherently low yield of latex at commercial age. Another instance could be cited as possible source of genetic material, such as the man-made forest of either Osmeña or Impalutao Reforestation Project where some of the best pines are found. Their exemplary characteristics of having long and straight boles justify the need of preserving them through the process of vegetative propagation. This should be given ample attention inasmuch as they are now ready for harvest. Otherwise, history would repeat itself and unknowingly they would be missed again in the same manner as their valuable parents were lost two or three decades ago.

Establishment of Seed Orchards. — Seed orchards are indispensable in forest tree improvement since they serve as sources of certified seeds and laboratory for genetic and breeding experiments.

In their establishment, the desirable species should first be surveyed which involves the cataloguing of superior or plus trees from nearby plantation or virgin forest in each region. Only the varieties or species of interest should be tested for genetic superiority in order to specifically determine which of the existing tree species are to be preserved. Then the plant characters are classified quantitatively and qualitatively to facilitate experiments on tree hybridization. In order to insure the continuous productivity of the seed orchards, the necessary maintenance and protection should not be neglected.

In the Philippines, there is an urgent need of establishing a seed orchard in every region. This would pave the way to the accumulation of essential research materials besides serving as a temporary source of relatively superior seeds. Otherwise, it would be economically advisable to maintain a small seed orchard that is manageable by every reforestation project. This is now a dire necessity inasmuch as the climax species are already being planted to some areas. Besides, such a great investment should be fruitful that a genetically superior seed should be used for every seedling raised in the nursery and planted in the field. In places, therefore, where certain species thrive well seed orchards should be established and maintained. An initial project could be demonstrated with the establishment of a pilot seed orchard for benguet pine in Baguio,

Cebu, and Bukidnon. Subsequently, other projects of a variety of commercial species could be established in strategically situated places.

Cytologic and Cytogenetic Research. — A knowledge on the cytological features of the genetic materials is of paramount importance in the process of hybridization. This calls, therefore, for a systematic cytological study on every varietal strain or species found in the orchard which involves studies on chromosome numbers, chromosome aberrations, pollen storage, fertility and sterility, polyploidy, and other cellular characteristics, including a cytogenetic study of the mutants produced through natural and artificial irradiation. These studies would provide the basic information to enable one to initiate and lay the foundation of tree breeding experiments. Moreover, the derivable results would yield the necessary taxonomic data for the phylogenetic classification as well as nomenclature of the breeding stocks and progenies.

Provenance Studies. — Having collected the valuable materials within a specific region, it is important to test the adaptability of such materials to other regions. A study, therefore, on the ecological aspect of the different breeding materials should be conducted to include geographical, altitudinal, and other climatic variations. Simultaneously, field trials could be conducted to study heritability, combining ability, and progeny relationships. In this case, the environmental effect could be assessed to furnish the essential data for determining the genotypic variation of every commercial species. Eventually the mode of inheritance for a specific character or the applicability of the mendelian principles on different tree characteristics could be properly evaluated.

Forest Tree Breeding Research. — The creation of new strains of species possessing desirable characteristics could be possible through the cross-breeding of superior trees followed by drastic selection of individuals with good characters. Controlled or uncontrolled breeding could be employed which necessitates a thorough knowledge on the floral morphology, phenology, incompatibility systems, pollenology, and breeding methods. Hybrid production could be further materialized by modifying the conventional breeding method such as the application of heterosis breeding, mutational breeding, breeding of introduced species, breeding for resistance to pests and diseases, including wood properties. Finally, the performance of the selected strains or hybrids should be compared with the normal variety to critically evaluate their economic potentialities. In this process, one could bring forth tree hybrids that foresters could be proud of. In the course of time, fast-growing strains coupled with superior wood qualities could be commercially produced and made available to the public in answer to the scarcity problem of high-quality wood.

A specific case on tree breeding problem in the Philippines is worthwhile investigating such as the transfer of a desirable character from one species to another. Accordingly, *Cinchona ledgeriana* Moens. has a very high alkaloid content but is slow-growing. On the other hand, *Cinchona succirubra* Pav. has a very low alkaloid content but is very fast-growing. Hence, if the growth or the alkaloid content of either of the species could be transferred to the right parent through reciprocal crosses or backcrosses, a hybrid could be produced which is fast-growing and simultaneously of high alkaloid content. This process is paralleled to the production of high-yielding rubber trees in Basilan which are undoubtedly the result of breeding experiments abroad. Similarly, the long-boled, fast-growing benguet pine at Cebu and Bukidnon could be further improved to increase their diameter growth. Supplemental genetic investigation should also be conducted to unmask the inheritance pattern of some distinctive features such as long internodes, branchiness, and dominance of the crown. Likewise, breeding other species like

mahogany, narra, molave, acle, and the dipterocarps should be given ample attention and action.

The Silvicultural Approach

A genetically and physiologically superior seed would not normally grow into an elite tree unless it is given the proper care for its establishment and development. Silvicultural studies especially on the various site factors should, therefore, be conducted to be able to specify the silvical requirements of our forest trees. Seed storage, germination, root-prunning, spacing, and other nursery practices should be scientifically studied or re-investigated to be able to assess their effects on the phenotype and genotype of each species. At the plantations, the different silvicultural systems should be thoroughly studied to determine their specific relation to tree improvement. A basic knowledge on these systems would provide the needed information as to which is the most feasible system in bringing forth a high-quality timber stand. In the logging areas, the residuals possessing superior qualities should be discriminately left to regenerate the future stands. Subsequently, they should be treated in accordance with the existing Timber Stand Improvement of the Bureau of Forestry.

Silvical researches should also be geared towards the relation of tree physiology to genetics and breeding. This is important because the relationship is necessary to categorically determine the specific characters that are genetically controlled. This calls for a thorough knowledge on the basic metabolic processes involved in the phenomenon of tree growth. Studies are, therefore, necessary on the induction of flowering, photoperiodism, photosynthesis, transpiration, and others. The prospect of using growth regulators should warrant investigation to determine any positive response of the commercial species. In this connection, growth substances such as indoleacetic acid, gibberellic acid, kinetin, and other known auxins should be exploited. Fertilizer studies should be similarly conducted to determine the food requirements of our forest trees for proper nutrition. Atomic energy in the form of radioisotopes or atomic rays such as ultraviolet rays, x-rays, gamma rays, alpha rays, and beta rays should be availed of to enable the silviculturist and geneticist evaluate the silvical data as early as possible.

The Participating Agencies

A coordination of activities for a well-planned timber improvement program is a dire necessity for an effective and successful research. This calls for the cooperation of the following forestry agencies together with their probable research areas and activities. The U.P. College of Forestry should institute courses in forest genetics, plant breeding, and tree physiology to overcome the lack of technical personnel to implement the program. Graduate courses should be offered and if possible a program leading to the master's degree be planned on forest genetics. Meanwhile, technical guidance should be offered voluntarily to receptive investigators or collaborators of existing or proposed tree improvement research. Basic researches on forest genetics, silvics and silviculture, tree physiology and pathology should be encouraged and given the necessary support in this institution. The Reforestation Administration should endeavor to establish regional seed orchards. Field or progeny trials should be conducted in addition to hybridization studies on forest trees. With the cooperation of the different Forest Experiment Stations of the Bureau of Forestry, progeny testing, introduction of exotic species, and ecological studies should be conducted to know categorically the effect of environment on the growth of commercial trees. The Forest Products Research Institute could contribute a great deal in terms of scientific investigations on the wood properties of the breeding stocks and progenies. The pulp characteristics, fiber length, grain and texture, strength, durability, specific gravity, cellulose yield, ex-

tractives, and other important characteristics of potential hybrids should be known through an effective research of the institute. The wood-using industries should also conduct studies on the quality and saleability of the finished products, together with the economics of the improved varieties and species, like the inbreds and hybrids. An alternative but a philanthropic contribution would be a financial support to the various projects within the scope of the program.

SUMMARY

The Philippines today is destroying its forest faster than any country in the world. Illegal kaiñgin, timber smuggling, and indiscriminate logging have drained much of the forest resource. However, no immediate measures of tree improvement are taken to check this critical forest problem. Agriculture has long developed high-yielding varieties of rice, corn, abaca, and other crops but practically no improved tree varieties or hybrids could be brought to light yet, after more than half a century of forestry practice in the Philippines.

A solution to the foreseeable problem of timber shortage has been proposed through the implementation of a well-planned forest tree improvement research. This involves studies on the genetic and silvicultural aspects of improving the quality of existing tree species that are of commercial importance. Efforts would be exerted to create a population of genetically superior trees that are expected to answer the dire needs of the wood-using industries. Attainment of this objective calls for the production of hybrids that are characteristically fast-growing, resistant to pests and diseases, of wider ecological adaptation, and superior wood quality. The castle of this dream could be built up through the cooperative efforts of the various forestry agencies that would undertake the different phases of the research program. Most possibly, the creation of a Committee on Forest Tree Improvement could be an incendiary step to keep the ball rolling. To begin with, the committee would explore the possibilities of securing the necessary research fund which is considered as the lifeblood of the proposed undertakings.

On the whole, the time is already ripe; hence, the Filipino Foresters should appropriately act now in order to create and perpetuate better trees for tomorrow and a greener Philippine forest.

Industrial Charcoal . . .

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Table 6. *Calorific value of coke, coking coal and wood charcoals*

Kind of Fuel	Volatile matter per cent[k]	Fixed carbon per cent[k]	Heating value per cent[k]
Coking coal[l]	19.0	76.0	7500
Coke[l]	5.0	87.0	7100
Black charcoal (Japan)[m]	12.0	86.0	7158
White charcoal (Japan)[m]	5.0	93.0	7235
Spruce wood charcoal (U.S.A.)[l]	14.4	83.6	7310
Coconut shell charcoal (Philippines)[n]	18.8	77.4	6700
Ipil-ipil wood charcoal (Philippines)[o]	11.0	86.7	7472

[k] Based on moisture-free charcoal.

[l] Anonymous. 1955. Wood burning. Food and Agricultural Organization of the United Nations, Rome, Italy. p. 4

[m] Kishimoto, S. 1961. Firewood and charcoal. Chemical utilization of wood. Overseas Technical Cooperation Agency, Ministry of Agriculture and Forestry, Japan. pp. 272-273.

[n] Coconut shell charcoal was obtained from a commercial sample.

[o] Average of 6 distillation runs. The calorific values of coconut shell and ipil-ipil charcoals were determined by the sodium peroxide method at the Institute.