CONTRIBUTIONS OF SILVICULTURAL PRACTICES OTHER THAN GENETICS TO FOREST TREES

by

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The genetic improvement from past work with agricultural crops can be classified into three types. One type of improvement is that in which the crop is bred for resistance to some type of disease or insect damage. The ability to or the ability not to raise a given crop may depend upon the success of this type of breeding program. A second type of improvement is through the selection and breeding to increase the proportion of some particular chemical constituent of the plant. Selection and breeding with sugar beet varieties has increased the sugar content from six to more than twenty percent for a 3.3 fold increase. Similar increases have been obtained by selecting strains of rubber trees with high latex yielding capacities. Where the photosynthetic productivity is not altered but rather the relative proportion of some constituent of the plant is increased, selection and breeding has usually resulted in increases in productivity in the range of 300 to 400 percent. The third type of improvement through selection and breeding is in the increase in general productivity of the plant with regard to gross volume production, say in bushels per acre in corn or wheat or tons of hay, or quanitty of cellulose fiber per acre. This third type of improvement is the one that has gained the widest reputatiot among laymen and is the one about which there is the greatest misunderstanding, Past experience of selection and breeding programs with corn, wheat, sorgham, peanuts and so forth indicates that selection and breeding programs have increased the growth productivity of these plant crops in the order of 25 to 30 percent. These three types of genetic improvement might be succinctly designated as the all or none, the qualitative, and the quantitative. All three types of genetic improvement have been the result of many generations of selection and breeding.

Trees, unlike agricultural crops, have not been cultivated for thousands or ten thousands of years and have not undergone a previous history of selection and breeding. Even the old open-pollinated varieties of agricultural crops represent the best of selections that have had their origins in the pre-Egyptian times of 3,000 B. C, Therefore, it is reasonable to expect that we will have considerably greater increases in productivity from our early genetics work with trees. It is not reasonable, however, to expect, as some publications do, that increases of 50 to 300 percent will be realized from the first generations of selection and breeding with forest trees. While it is not possible to predict precisely the increases to be made in our early selection and breeding work, increases of magnitudes much larger than 15 to 30 percent seem unreasonable.

Faced with our expanding population which has already made the timber resource review report out-of-date, and our diminishing supplies of fossil fuels and raw materials, one must expect that the demands upon the plant growth of trees will increase considerably over the next 15 to 200 years. If forestry is to meet these demands, we must find some means of increasing forest production other than the method of tree improvement through selection and breeding. Fertilization and cultivation are two obvious methods of increasing the productivity of forest lands. Heretofore, such practices were not economically feasible because of the low price of wood as a raw material. However, there has been a tremendous increase in the price of this product from almost nothing before World War II to $5.00 to $7.00 per cord on the current market. Soil site index studies by Barnes and Ralston[1/] and others have indicated that plantations in the southeast coastal plain are growing at very rapid rates. The general evidence is that five to ten percent of our lands in the southeast coastal plain are capable of growing better than two and a half cords of wood per acre under current management and planting practices. General evidence from the literature and studies in this country and abroad indicates that cultivation can increase the annual volume growth per acre by about 05 percent. Similarly past experience has indicated that we can expect a 65 percent increase in productivity through the use of fertilizers on our better sites.

Let us examine the production to be realized from fertilization, cultivation, and genetics improvement when combined on a hypothetical land management case.

On the best five to ten percent of our land in the southeast coastal plain a potential yield of two and a half cords per acre is obtainable with our current planting and management practices. Suppose a program of land management that calls for clearing and cultivation of the land with modern heavy machinery at a cost of twenty dollars per acre, and suppose this land is cultivated twice a year after planting for three subsequent years, with a cost of $15 per acre for cultivation. The total cost of such a cultivation program including compound interest at five percent semi-annually would be $214.60. If this cultivation increased productivity of the land 05 percent, the increase would be from two and a half cords per acre per year to 4.62 cords per acre per year for a total production increase of 2.12 cords per year for twenty-five years. This increase would amount to 53 cords and at $7.00 per cord would yield a $370.10 gross return. The net return on the investment of cultivation would therefore be $165.60; a net profit of 77 percent after deducting the annual costs of cultivation and an interest of five percent compounded semi-annually for 25 years.

[1/] Barnes, R. L. and C. W. Ralston. 1955. Soil factors related to growth and yield of Slash pine plantations, Bulletin 559, Agricultural Experiment Station, Gainesville, Fla.

Three hundred pounds of the typical commercial fertilizer costs about $6.00 and the cost of application would be about $4.00. Therefore, if we fertilize an acre of land with 300 pounds of 4-7-5 every third year with a cost of $10.00 per year, the total cost of fertilization at the end of the twenty-five year period including five percent interest compounded semi-annually would be $147.17. If this fertilization increased productivity 65 percent from the base of two and a half cords per acre per year, the increase in production would be 1.62 cords per acre per year or an increase of 40.6 cords for a twenty-five year period, which if valued at $7.00 per cord, would be a gross return of $284.00. The net return of the investment of fertilization is $136.87, a profit of 93 percent over and above the cost of application and the usual interest costs of five percent compounded semi-annually. A 2.1 cord per acre increase from cultivation and a 1.62 cord per acre per year increase from fertilization brings the cord production of our base acre of land to 6.24 cords per acre per year as a potential growth. When high quality selected trees are available as seed sources in orchards we can expect the production of seed to be cheaper than it is at present. Therefore, for practically no cost for a hypothetical genetic improvement of 30 percent (30th of 6.24 cords) we will increase the productivity another 1,87 cords per acre per year to put the total per acre production to 3.11 cords per acre per year with the combined intensive management practices of the use of cultivation, fertilization, and genetics.

Those who find difficulty in imagining this picture of a threefold increase over the base level of production as we have it today with current management practices should realize that this discussion pertains only to the best acre in 10 or 2U, and that undoubtedly these increases will not be economically obtained from all of our land.