INCORPORATING TREE IMPROVEMENT IN NATURAL REGENERATION

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Abstract. --A large fraction of forest stands in the Eastern United States are naturally regenerated by means of different sivil-cultural systems. Although regeneration is a genetic process, limited efforts were made to apply genetic principles in managing naturally regenerated populations. Geneticists have suggested that "dysgenic practices" should be avoided, but it is not clear as to what management practices constitute dysgenic activities. This difficulty originates from the limited knowledge available on genetic consequences of manage-ment practices. In this paper, we discuss the means of evaluating the available information, classify biological and cultural factors which needs research, and propose possible organization of research and management capabilities to improve the understanding of the genetic impacts of forest management in natural regeneration.

Additional keywords: Natural regeneration, dysgenic practice,

The National Forests in the Eastern Region (R-9) regenerated over 60,000 acres in Fiscal Year 1987. Of this 75 percent was regnerated naturally. It is also belived that natural regeneration represents a significant portion of regeneration on non-National Forest lands in the Northeastern Area. This paper is a follow up and expansion of our previous paper (Murphy and Kang 1985) in which we discussed the need for coordinated research efforts in naturally regenerated lands. This paper also reflects some thoughts developed during an informal meeting held in 1987 among some geneticists and silviculturists from across the Eastern Region.

The majority of tree improvemnet efforts in the Eastern USA have been directed toward species that had some potential for artificial reforestation. The application of genetic principles to natural regneration has essentially been confined to general inclinations to avoid Dysgenic practices. This concept, which is often associated with silvicultural practices, tends to divide silviculturists and geneticist into two gropus. The first being that dysgenic practices are bad. The second is that there is enough variation and the number of individuals with natural regeneration that just good silvicultural practices will overcome any effects of past dysgenic practices.

DYSGENIC PRACTICE

Geneticists and silviculturists have traditionally thought of dysgenic practice in terms of high grading, diameter limit cuts, and other such

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practices. In 1976, U.S. Congress passed the National Forest Management Act (USDA 1979), which mandated the National Forest System to do multiple resource management. Therefore, it is worthwhile to examine the concept of dysgenic practice more in line with present plans and objectives of forest management. Dysgenic has been defined as "detrimental to the genetic qualities of future generations," (Synder, 1972). While the definition may still be considered valid, attention must be focused on "genetic qualities". In the past, most managers thought of genetic qualities in terms of increased yields, quality sawlogs, and other so called traditional timber values. We now must think of genetic qualities of forest trees in terms of wildlife, recreation, biotic diversity, as well as the traditional timber values. Therefore, to define dysgenic practice, we must define the genetic qualities we are managing and quantify the impacts of silvicultural practices that may be dysgenic to these newly introduced criteria.

CHANGING ROLE OF FOREST GENETICIST

Wright (1962) stated that "good silvicultural practice will accomplish as much gain as 'genetic selection' in a naturally reproduced stand." He further stated that "the tree breeder will do better by encouraging the intensive silviculturists (rather) than taking over his job. " Wright's statements may be interpreted as saying that "good silviculture is (=) good genetics", or good silviculture can replace good genetics. During the last 20 years, public demands and management objectives and philosophy have changed drastically, and managers deal with multi-dimensional problems. Consequently, we can no longer contend with the notion that good silviculture can replace good genetics or vice versa. Geneticists and tree improvement specialists need to develop good working relations with silviculturists and land managers. They need to focus on being involved, and be responsive to needs of silviculture by: (1) providing information on genetic consequences of different silvicultural practices, especially those on the rate and direction of change due to management practices in multiple criteria. (2) Provide functional banks of materials so that multiple management needs can be readily met.

APPROACH

To carry out the new role with respect to natural regeneration, forest geneticists need to accept the fact that we are dealing with complex problems. Some might say it is too complex and long-term that it can not be resolved. Others might liken it to putting a large complex puzzle together without having a picture on the box cover to go by. These perceptions might be true, but we still need to attempt to solve the dilemma by starting to put the puzzles together.

We must first separate the pieces, (different factors). Some of the factors are listed in Table 1. We must then group what appears to be similar color or object pieces, (i.e., determine what factors can be looked at separately). Table 1 shows the factors under three different categories, Silviculture, Genetics, and Management. Considerable overlap and interplay exist among the groups. We must then look at the groups of pieces to determine what we know about them, (what research has already been done). We then must try to learn how some of the pieces might go together, (additional short-term research). Finally we must start trying to fit the groups together. These processes take time, but with cooperation we can make progress.

Table 1.--Factors involved in understanding the role of tree improvement in natural regeneration.

Silviculture	Genetics	Management
Origin of Stand	Pollen Production and Dispersal	Objectives
Source of Reproduction	Seed Production and Dispersal	Economics
Seed Migration	Genetic Attributes	Growth/ Yield
Germination	Heritabilities	
Survival	Inbreeding	
Growth	Additive Gene Complexes	
Mortality Expectations		
Silvicultural Practices		
Micro-site Variation		

Table 1 lists the factors (puzzles) according to three different functional groups. The genetic factor could be also be further classified into two main hierarchial levels.

1. Genetics of large areas (bio-diversity, landscape ecology, etc.) This could in fact be the entire picture.

2. Genetics of stands and how we influence it. We probably will have to break this down and get a good feel for the solutions before we complete the diversity group. This group should probably be broken into the following sub groups:

   a. define genetic qualities and the impacts of silviculture on those qualities.

   b. determine the impacts of phenotypic selection on the genetic resource.

   c. determine juvenile-mature correlations for phenotypic traits for application in intermediate silvicultural practices.

One important principle to consider in addressing the above issues is to break the problems into workable sub-groups, but not forgetting that they must be put together before becoming applicable.

IMPLEMENTATION

To start working on the puzzle we must first enlist a team that truly wants to put the picture together. The team must be organized to prevent needless duplications or omissions.

The team needs to divide into workable groups with sufficient coordination to prevent duplication. Once the groups have identified and coordinated specific problems, existing research, publications, and personnel knowledge should be screened for contributions to the solutions.

The first output may be the identification of specific short-term research efforts that are needed. The interim output will be practical management guides that the land manager can use in meeting land management objects now and and in the future.

The solution to this very complex problem will certainly utilize the many attributes of computer technology. The transfer of the technology to application of the solution will be enhanced by the combination of computer technology and perhaps the wizardry of video graphics.

The accomplishment of putting the pieces together will require active participation and coordination of land managers and researchers from State, Private, and Federal organizations.

Unless forest geneticists approach this problem methodically with a great deal of coordiantion, our current concern will remain to be "beating of the puzzle box". Can a diverse group located across the twenty Eastern States accomplish such a task? Not without a catalyst. It is believed that the USDA Forest Service has such a catalyst. The Eastern Region of the Forest Service has a program going called PROJECT SPIRIT. The Washington Office has a program called EAGLES. The Northeastern Station has a program called GENESIS. These programs have one thing in common. Their objective is to promote an innovative, integrated approach to problem solving. This catalyst, associated with the membership of North Eastern Forest Tree Improvement Council and Nnorth Central Tree Improvement Association, can be the team needed to put the puzzle together.

WHAT IF

Under the innovative mode of spirit we have in the Region a process called pilot proposals. Perhaps a proposal along the following lines would be the impetus to initiate the catalyst.

Establish a multi-discipline and multi-branch Forest Service team to develop, integrate, and implement a network to coordinate an orderly investigation regarding genetics of forest trees in natural regeneration including implications to biotic diversity. The team would consist of a geneticist, an ecologist, and a silviculturist from each branch of the Forest Service, R-9 NFS, NCFES, NEFES, and NA S&PF.

The team would have a simple set of tasks:

1. Identify specific problem areas.

2. Determine possible areas where data presently exists to help to solve the problem.

3. Identify the expertise available, including Universities, that can provide information and implement short or long term research.

4. Assemble an overall plan for attacking the problem and for obtaining the necessary funding.

5. Serve as a coordinating unit for the assembling of results, determining further studies, and the development of management practices for implementation.

We believe that this may be the approach needed to get the team working to solve the puzzle.

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