THE QUESTION OF GENETIC MANAGEMENT OF MINOR OR UNDOMESTICATED SPECIES--AN OUTSIDER'S REACTION

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Abstract.--Many of the tree species in the Southeast are not being subjected to breeding work, either because other species are preferred, or because although important wood sources they are not favoured for intensive cultivation. Even with minor species for which orchard programs exist the availability of seed from the orchards can actually provide a disincentive to the provision of a broad genetic base in a form that is readily utilised and which may ultimately be needed.

Considerations are examined for the genetic management of such species in preparedness for future changes in the situation. While there is no apparent problem with overall gene conservation, there are difficulties in securing some soundly-based genetic improvement at minimal outlays. Pilot-scale cultivation of the species could provide the opportunity for judicious improvement measures, largely incidental to the cultivation. A key factor will be establishing, where possible, plantations that are broadly based genetically.

STATUS OF SPECIES

There are many tree species in the Southeast which are not being genetically improved because they are not favoured propositions for regeneration and intensive management. Reasons for this include:

1. inherently slow growth rates and/or poor tree form, at least in comparison with the preferred species,

2. no special premium on wood values,

3. difficulties of artificial regeneration involving:

   seed collection

   seed handling and storage

   nursery culture and plantation establishment

   slow initial growth and inflated weeding costs

4. site sensitivity, either requiring very good land, or leading to uneven and often poor growth,

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5. possibly, difficulties arising with growing the species in pure stands.

Even if seed orchards exist the species are only being improved inasmuch as they are being regenerated artificially. Nevertheless, such species are of interest, over and above any consideration of straightout conservation for one or more of the following reasons.

1. Many of them occupy large areas of land, which are likely to remain in such *species* for a long time.

2. Some are potential substitutes for loblolly and slash pines, these being basically the remaining or "minor" pines species. As such they could rise in importance if loblolly or slash pine should fall into disfavour, through pressures to plant more difficult sites, through increased concentrations accentuating known disease hazards, or through the emergence of new factors.

3. Others, namely the hardwoods, are largely complementary to the pines in their utilization characteristics. They are sources of short-fibred pulp and potentially of sawn timber. However, only black walnut, black cherry and perhaps green ash fall into the high-value specialty bracket, while at the other end of the scale tulip poplar could at least partially substitute for pines

Then there are some special cases like Fraser fir, which provides Christmas trees.

CONSIDERATIONS FOR GENETIC MANAGEMENT

Since those species are of interest we must be concerned with their genetic management in terms of:

- preservation of basic gene resources,

- achieving some measure of actual genetic improvement, or at least heading off crop deterioration.

The gene resource question is not a problem in itself, since the occurrence of such species, often in numerous small demes but well scattered over large areas, would seem to be a highly favourable situation for preserving the total gene resources (cf Brown, 1978). Moreover, it is understood that the U.S. Forest Service is currently examining this question. That the demes should often be decidedly inbred should not matter in relation to preservation of alleles over large regions, while the 'soft' (density-dependent) selection situations that can prevail under conditions of natural regeneration mean that homozygotes can be selectively eliminated in favour of balanced heterozygotes at little cost in terms of final crop fitness. Nevertheless, natural stands, through the inbreeding effects and through the tendency to give relatively low field heritabilities, do not provide such readily usable gene resources as broadly-based plantations would.

Genetic improvement is much more of a problem. To be practised at all it requires reasonably intensive management of the stands (compared with laissez-faire exploitation) and an important (if not necessarily essential) component of such management is artificial regeneration. While this approach would normally be the most profitable for those who acquire land as a basis for sustained yield wood production (Franklin, 1980), many of the actual land owners do not have the financial resources to embark on intensive management, and if they did they would be likely to establish with P. taeda. Artificial regeneration of the hardwood species just for pulpwood crops would in most cases appear very unattractive economically. Establishment for these species for producing high quality logs may have some attractions, but the generally modest inherent value of the timber or the site requirements for producing quality logs would tend to limit the scale on which this might be done.

In any case, if artificial regeneration is to be done by planting, there will be a heavy outlay and a high proportion of the genotypes planted will need to be fully fit. Exceptions, though, would be species that are readily propoagated as cuttings. In these, a certain proportion of unsatisfactory genotypes in seedlots could be eliminated quite painlessly during the early stages of selecting genotypes for vegetative propagation. Direct seeding could save costs (although it might still require good site preparation) and can allow for a greater wastage of genotypes, but will require considerably more seed. Its feasibility as an option is not generally established, but it is potentially attractive for low-effort genetic management on account of the scope it allows for natural selection.

These factors all argue against a heavy commitment to genetic improvement of such species. Nevertheless, it seems prudent to have their genetic management in hand, so that if and when it is desired to cultivate the species there should be satisfactory seed sources available which would represent the genetic improvement that could be obtained, with minimum outlay, over a period of time.

For any particular species (other than the major ones that are already subject to intensive breeding programmes), it would appear to be a question of:

Does one have the management of genetic material in hand, with a low outlay on the actual genetic improvement work, so as to provide for:

1. shakeout of neighbourhood inbreeding effects,

2. reasonably effective selection in the field,

3. pursuing continued genetic improvement on a satisfactory genetic base?

This question can be resolved into a further series of questions:

1. Are there seed orchards?

2. If so,

    a. are the orchards likely to represent appreciable genetic improvement? In other words, was there a worthwhile heritability under the conditions of initial field selection?

b. do the seed orchards represent a worthwhile genetic base for going further? This requires, preferably, that the seed orchards should represent some genetic improvement in themselves but, much more important, that the orchard clones available within a safe breeding region should be numerous, say > 200, and unrelated.

c. if there are sufficient clones, are there progeny test planting which would allow effective second-generation selection? It would seem important that such plantings should give good individual heritabilities (to avoid the need for elaborate selection procedures), and that the layout should not be conduciv to undue inbreeding, since such plantings would effectively be seedling seed orchards.

3. If there are no orchards, or if neither the orchards nor the progeny tests represent a satisfactory base for long-term genetic management, are there broadly-based plantations which would meet the basic requirements? These would have to be based on large numbers of unrelated parents, and have had a history that would be expected to give worthwhile field heritabilities which would make mass-selectio reasonably efficient.

A POTENTIAL PROBLEM

From this analysis I can see one particular strategy problem brewing, a problem that would be more psychological than techincal in its basis. It concerns the species for which seed orchards have been established with limited numbers of intensively selected clones, and are now producing seed far in excess of current planting requirements. Several of the 'minor' pine species clearly belong in this category (Anon., 1976).

In hindsight, it seems that seed orchards, while often an appropriate first step for genetic improvement, may be appropriate only when a firm and high-level commitment to this improvement can be sustained. Establishing seed orchards without intensive large-scale follow-up may achieve very little. Indeed I suggest it has some positive dangers. The presence of orchards, whose production is not really being used, must serve as a powerful disincentive to establishing plantations with broadly-based seedlots. With some such species current plantings are essentially on an experimental scale, and even if orchard seed is not used it can be all too easy to obtain the requisite seed just from a few neighbouring trees.

CONCLUDING REMARKS

I use the term "genetic management" partly to avoid any notion of a heavy investment in breeding work, and partly with a view to being in a state of preparedness for any future situation in which there could be an abrupt increase in the cultivation of the species in question.

Very important could be the genetic improvement measures that can be carried out incidental to any cultivation of the species that is already being practised, or to any pilot work that is being done on the cultivation. The

appropriate scale of the pilot operations may in itself be arbitrary, in which case the scale could well be fixed to satisfy considerations of genetic management. If the seed can be collected in the course of setting up genecological studies that remain to he done, so much the better. In any case the best prospects seem to lie in bringing together a broad genetic base, and creating a reasonable field heritability, and allowing natural and silvicultural selection to operate. Present economic conditions and the lack of day-to-day urgency must be a brake on immediate action. So will the rather fluid state of the respective roles of government and private agencies. I would urge, though that responsibilities be decided now and that firm targets be set for, say, the next five years.

Much will depend on biological constraints, such as the seed production and other propagation characteristics of particular species, and on the sort of field heritabilities that can be expected. The prospective payoffs, modest though they might seem, must be weighed against the possibility of dysgenic effects in the absence of any positive action.

ACKNOWLEDGMENTS

Thanks are extended to Dr. Bob Kellison for helpful criticism of a draft. The paper was prepared for the North Carolina State University Small Woodlot Owner's Cooperative Program, and while the author held a David Henry Scholarship administered by New Zealand Forest Products Ltd.

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