# SEED ORCHARD PROBLEMS - IN RETROSPECT AND ANTICIPATION

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Problems confronting seed orchard managers are discussed including those everyday problems of establishment, maintenance, record keeping and protection.

In addition, certain public relation problems are mentioned which bear on harmony and good will from both "outsiders" and "insiders".

Finally, questions are raised concerning anticipated biological problems and man's possible control over.

## EVERYDAY PROBLEMS

### Establishment

Establishment includes readying the land for the orchard and then establishing the grafts by whatever method one might be using.

For many of us readying the land for the orchard includes land clearing and so that attendant problems of avoiding soil compaction, Fomes annosus (if the previous stand contained much pine), providing proper drainage and leveling should be considered. Because we're talking money top management may balk at what to them may seem excessive costs but in the long run we can save money by doing a careful and thorough land clearing job before the first grafted tree is placed on it. You will note that I mentioned leveling -- since we envision collecting our seed by vacuum sweeping seed in our loblolly pine seed orchards we will need level terrain in order to recover as much of the seed as possible. Therefore, it's entirely possible that many of us who established our orchards before the advent of the pine seed vacuum will have to go back into our orchards and level the best way we can by filling or otherwise leveling the seed orchard surface as best we can.

Oftentimes it is necessary to clear an isolation strip around the perimeter of our orchards. The purpose of this strip is to reduce contamination from unwanted pollen outside the seed orchard. I've been convinced for some time that where we are establishing loblolly pine seed orchards almost anywhere within its natural range that we will have unwanted outside pollen in our orchard. Under proper conditions we know that pine pollen will "fly" for long distances. The magic number is at least 400 feet and this is what most of us are using in making allowances for our isolation zone. However, we've noticed for some time that we are getting filled seed in the orchard on ramets much further than 400 feet from a known pollen source. The implication of Squillace's (1967) study with slash pine showed that when male flowers are absent (or extremely rare) in the orchard, wind-borne pollen from stands more than 400 feet away is sufficient to pollinate the female flowers effectively. This possibility of outside pollen contamination will probably prove more of a problem to us earlier in the history of our orchards than later due to the availability of pollen from within our orchards. As our orchards mature, more and more pollen should become available thereby hopefully "saturating" the orchard with seed orchard pollen. In the early stages, however, much of this "saturation" may well come from the outside and we may as well recognize it.

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Since many of us are still grafting, I would be remiss in not mentioning it as a problem. For us it's a problem because it comes at a time of the year when we would like to be doing more control pollinating and other important seed orchard work. To others, just getting started with their seed orchards, a certain amount of apprehension is only natural. In any event, grafting is time consuming and a technique or techniques suitable to your particular needs must be worked out. It is always somewhat amusing to see, yet frustrating at the same time, the inordinate interest displayed by "outsiders" and "insiders" in grafting. However, once a grafting technique is worked out for your particular needs it's just another mechanical process and is merely a means toward the end.

Before leaving grafting, graft incompatibility should be mentioned. Graft incompatibility costs us both in time and the loss of valuable clones. Clark Lantz (personal communication) informed me that data obtained as a result of a questionnaire in which 19 organizations participated that 22% of the loblolly pine clones grafted showed definite signs of incompatibility. Lantz went on to say that he estimates the overall clonal loss is approximately 15%. R. Corti and associates (1968) found in essence that grafting incompatibility is a complicated phenomenon. Since a solution does not appear to be in sight for the present most of us are "by-passing" the problem by substituting other clones but this has cost us both money and time, and has somewhat complicated our progeny testing program.

Graft incompatibility, other mysterious physiological problems, plus just plain transplanting mortality often makes it necessary to replant or replace grafts in the orchard. Due to the competitive effects of adjacent grafts a point in time is soon reached when replacement planting is inadvisable. In my opinion this can come as soon as three years following the establishment of the main orchard. It isn't the question whether or not a graft transplanted at a later date will live, but a more relevant question is what such a transplant would contribute to the seed orchard. Large holes excepted I've seen transplanting done where the grafts are sometimes "buried alive".

Records

Good records are most vital and necessary to successful seed orchard management. Seed orchard management is a job of details and we need to have some way of recording these various jobs. Quite obviously, in order to be helpful, records must provide us with information needed as well as record history.

A sample of the type records to be kept are: a. cost, b. establishment, c. various maintenance operations (such as fertilization, insect and disease control, mowing, etc.), d. maps showing location of clones, etc., e. flowering data by clones, and f. roguing just to mention a few.

We have tried various record keeping methods including Keysort and, to date, have not found the ideal system. In our operation where we have nearly 28,000 ramets to manage and several seed orchard locations involved good records are a must but most difficult to maintain.

Record keeping - a mundane job perhaps but nonetheless necessary and a big one. Ask any seed orchard manager.

## PUBLIC RELATIONS

People Problems

I've chosen to categorize so called "people" problems which could be categorized as public relation problems as falling into two categories: those within the various tree improvement programs which would include genetic workers, and "without". Only forester-type personnel will be considered.

One of our "without" problems concerns itself with the fact that we may have oversold the value of our programs (I'll discuss this later also as a "within" problem) to the point where many silviculturists simply don't believe our claims and view the programs with distruct. I believe we should keep in mind that genetics is just one of the methods whereby one can exercise control over wood quality. Many silvicultural operations such as initial spacing, thinning, fertilization, length of rotation exert a strong effect as well as the genetic material used. These are facts which the silviculturists recognize and those of us in tree improvement programs should also. We must remember that it will be the silviculturists and forest managers, in the long run, who will be working with the seed orchard progeny produced. I would suggest we maintain firm ties with them and not make exaggerated claims as to the genetic gains expected. I'll go into detail later concerning the nature of these claims.

Another "without" problem and related to the above is the fact that tree improvement - genetics is the current glamour field in forestry. Witness the industry ads in magazines and the many newspaper feature articles on the subject. It is only natural that those outside the program will feel some resentment and envy. I can't offer a solution. I can only point it out as a problem since such resentment can affect our programs.

One of our "within" problems that we have is overexaggerating genetic gains expected. All of us are pleased and proud that early results of progeny tests look extremely good. However, because these test results are still early I believe it would be most unwise and premature to extrapolate these early results too far into the future. Zobel (1967) says that even though "we may get 15 percent volume improvement through selection of superior trees, maybe 15 percent by fertilization, maybe a 4 percent in wood specific gravity, and a 10 percent gain through insect and disease resistance - but those percentages just can't be added to determine total gain. It doesn't work that way because each of these characteristics are correlated to each other."

As Van Buijtenen (1969) also points out ".... quantity and quality properties cannot be manipulated independently, but are strongly interrelated. A change in one of the properties invariably will modify others. In the southern pines, for example, specific gravity and growth rate have been shown to be strongly and negatively correlated." For example, suppose one fertilizes and thereby increases growth. There is a good chance that this increase in growth will be accompanied by a decrease in specific gravity. Fertilization could also conceivably adversely affect the insect and disease resistance which we have bred into our seed orchard progeny. Furthermore, with each step of improvement the gain curve may flatten off and we soon reach an economic limit whereby it may cost us too much for the gain achieved. Perhaps our biological improvement

possible may total 50 percent, but we may find it expedient to stop at some figure less than 50 percent. The thought occurs that we may have to "de-sell", if necessary, to make sure we remain practical and realistic on genetic gains expected. Quite frankly, we have justified and sold our programs on much smaller gains and perhaps we need a return to some of these more modest figures quoted.

Honest differences of opinion still exist among forest geneticists as to the best method to use in order to achieve our ends -- which should be the production of improved seedlings. You will perhaps recall the open discussion of the various methods one should use which were published in the Journal of Forestry a few years ago. In my opinion this sort of disagreement could better be worked out between and among those geneticists concerned. It had no place being aired in a publication which most foresters read because it only created problems and raised questions. It only tends to confuse. I can speak from experience. Furthermore, I don't believe the opposing geneticists really convinced one another anyway so why bother in the first place.

## ANTICIPATED PROBLEMS

After reading this section the reader may rightly question the section heading since some of the problems which follow are present day ones. However, it is felt that, for the main, the major impact of the problems which follow lie in the future.

### Soil Compaction

Soil compaction and its attendant problems is going to be troublesome. Aside from compaction oftentimes caused in our initial land preparation throughout a given year numerous vehicular trips are made in our orchards. Each one contributes towards the soil compaction problem which will with time be compounded. The heavier the soil the more severe our problem will become. Also, wet weather vehicular trips are especially damaging. Floatation type equipment will help but will not completely alleviate the problem.

do not believe sub-soiling is going to be the universal solution to soil compaction. Not only will we possibly be subjecting the orchards to possible disease such as (Fomes annosus) but also physical root damage is bound to occur. Sub-soiling also tends to make the soil surface rough which will create problems when we use our seed harvester vacuum which will require a smooth surface for maximum efficiency.

### Disease

Fomes annosus is just a single example of the diseases we must consider. Orchards further south than Virginia I'm sure would also list Cronartium as one of their problems. With respect to Fomes annosus our fertilizing will most certainly bring the root systems up nearer the surface thereby increasing chances of root damage through mowing, for example, and certainly increases the risk of infection.

There is quite a bit of physical damage to trees in a seed orchard as a

result of using various types of equipment, i.e. mowers, etc., which also will provide avenues of infection. We know what usually causes this damage but it's most difficult to prevent.

Anything intensively managed such as a seed orchard is bound to have numerous diseases reported and they have been. I am sure we will learn of new ones as well. In our orchards these perhaps do not fall into the disease category as such but we also have unexplained physiological problems some of which eventually will kill the tree. I sometimes feel we may be minimizing losses caused by unexplained physiological factors and that if these losses were totaled we might be unpleasantly surprised.

Insects

As I now see it we are going to have to draw battle lines with respect to insects, especially cone and seed insects. We can perhaps tolerate aphids, red spider mite, etc., but ultimately flower, cone and seed insects must be reckoned with.

DeBarrs (1969) study in slash pine points up the need for such control. DeBarrs found that "of 442 flowers examined while still in the twig-bug stage of development in January that 52 percent had been damaged by thrips. Observations made in mid-March revealed that 38 percent of the 442 female flowers originally observed never matured to conelets because they had been killed by thrips in early February, prior to pollination. Of the 274 flowers that developed into first-year conelets, 50 percent had been injured by thrips prior to pollination; the damage ranged from slight to severe."

Presently all roads lead to systemics. At first glance using these systemics appears easy. One just merely broadcasts or disks in the systemic, if its in granular form, and wait for it to be assimilated by the tree and go to work. In actual practice it isn't quite that simple, however. In my organization we are using granular Thimet so my remarks will be confined to its use; however, other granular-type systemics have reacted similarly. To begin with, these systemics are extremely toxic and extreme care should be exercised in using them. We used nearly 5,000 pounds of Thimet this past season alone and this entails considerable exposure of a sort to personnel involved. The composition of these organophosphate compounds such as is contained in Thimet is apparently similar to nerve gas. Toxicity builds up and there is a threshold level in humans which should be closely watched. At the present we require our seed orchard personnel coming in contact with Thimet to take three blood tests annually so that the cholinesterase level may be watched. We also keep an antidote, atropine sulfate, on hand. To those of you using toxic materials, such as these systemics, I would recommend you locate the Poison Control Center nearest you if you do not already know it. We are observing every safety percaution we can think of and it still causes us considerable concern.

Where should these granular systemics be placed for maximum effectiveness? What is the effect of cover, tree size, and soil? We've noticed differences with respect to insect control for each of these.

What are the "carry-over" effects, if any? Do we apply once a year, if so, when? Do we need "booster shots" later on in the season; if so again -- when?

What is the effect, both short term and long term, on flowering when one uses these systemics?

What are the modes of absorption, translocation, and the metabolism effects within the tree?

These are just some of the questions I have concerning the use of these systemics.

To date, I am disappointed with the effects of the entomologists, with respect to providing good recommendations for insect cone and seed protection. I believe they've been too defensive. Not too long ago the entomologists kept asking for a "realistic and reliable estimate of the increased monetary value of a pound of improved seed so that we can have a cost benefit ratio study to determine whether or not the expenditure of insect control funds are justified on the basis of increased seed yields." I noted in a recent copy of Minutes - Contact Men's Meeting (1968) published by North Carolina State University that Merkel calculated that for slash pine that from $2.50 to $3.50 per tree could be spent for chemical control of insects and that seed yield was found to be approximately 2.5 times greater from treated areas than untreated areas. Perhaps with this incentive we can look for increased activity and better recommendations from entomologists in prescribing for effective control of cone and seed insects.

Flowering

Flowering is apparently quite clonal and presently we have perhaps 20 percent of our clones which are producing flowers in appreciable quantity. Bergman (1968) reports on the cone production varying greatly among clones with highly significant differences. What if progeny tests reveal these highly producing clones to be poor with respect to both general and specific combining ability and that roguing is in order? Should this prove the case and we lose the production from some of our most prolific clones, our cone and seed production could drop sharply. Yet, unless a clone can produce flowers, at least in moderate numbers, it doesn't do us much good in the orchard.

Do we declare a moratorium with respect to the time one can wait to see whether or not a clone will produce in quantity? If so, how long? Most of us are "waiting out" our low producers and hoping for the best. What is the age-size relationship to flowering? What assurance, if any, do we have that a clone will be a late "bloomer" with respect to flowering? I am concerned because some clones are just occupying space within our seed orchards with little evidence that these will produce cones in any quantity. Unless a clone can produce cones and seeds, the best phenotype or genotype does not belong in an operational type seed orchard such as most of us presently have.

Bergman also reports that three principal methods have been used to induce heavy flowering; artificial (usually mechanical) disturbance of the tree's transplant and root system, fertilization, and use of "flowering hormones."

The first method has not proven successful and in numerous cases the tree was killed by the treatment.

The method employing "flowering hormones" is still in its infancy and Sato's (1963) work in Japan on response using gibberellins is encouraging. However, most are in agreement that it is unlikely that a simple treatment generally effective in flower production will soon be developed. Furthermore, in order to be practical these hormones would have to be capable of being applied on a mass scale which is no small feat in itself.

In making future selections for our orchards we are going to examine fruitfulness more closely and eliminate those selections which we might have reason to suspect as being low or non-fruitful. Our immediate goal is seed; we'll leave it to others to preserve these non-fruitful genotypes if they wish to.

This brings us to fertilization which most of us are using today. The questions then become what, when, and how much? We will apparently have to learn these answers through trial and error. For example, we have a fertilizer study in progress in cooperation with Dr. C. B. Davey and Mr. Steve Webster, both of North Carolina State University, which involves nine different treatments and includes two different times of application. Through the results of this study we are hopeful that we can make more effective use of our fertilizer dollar. However, we should recognize that the empirical data obtained from one orchard may not be applicable in other orchards of different soil types. Should the right combinations be discovered Bergman suggests that fertilization increases the differences between clones with different flowering intensities and that good flowering clones often react more positively than poor clones which has the net result in decreasing the number of effective clones in the orchard. Again, what if progeny tests reveal that these high producing clones should be rogued? Matthews (1964) states, that ".... seed orchards exist to oroduce the greatest possible yield of well-filled viable seed." Quite obviously if it proved necessary to rogue our high seed producing clones we could, in essence, be defeating our purpose.

Flower production by sex may also be affected differently as a result of fertilization. We may find a fertilization treatment which will increase female flower production but decrease male flower production. Webster (private communication) cites recent study data whereby fertilization increased female flower production but reduced males.

To further complicate the fertilization problem Posey (1964) found a great variation between clones and families in the capacity to respond to fertilization. This would perhaps entail an overall assessment of gains realized based on the clones genetic worth and the increased seed yield realized.

Flowering phase - unless our clones or clone flower in phase with at least one other desirable clone we have this problem as well. I believe we only have one alternative in production orchards where we have a clone completely out of phase with other clones and that is to rogue them. To date, we've lost two in one orchard alone and both have been removed.

Loblolly pine is variable with respect to flowering time; this is being bourne out by our flower phenology studies. In Virginia, I am told that we have considerable inter-specific hybridization which takes place between loblolly and pond and/or pitch and we also have noted loblolly and shortleaf hybridizing. Dr. L. C. Saylor (private communication) says we have "tension zones" in Virginia where considerable hybridization occurs. I know that some of our selections have been made within these zones. If so, and our selection is an inter-specific hybrid a further opportunity exists for clones to be out of flowering phase.

## CONCLUSION

I do not want to end this talk on a pessimistic note because I really do not feel that way. I have raised just a few of the problems and I know that many of you could add considerably to the list.

In spite of problems raised several years ago when most of us began our tree improvement programs real progress has been made and much has been accomplished. The Southeastern United States is clearly leading the way and we all should take pride in being a part of it. I know I do.

We can anticipate our share of problems yet to come but perhaps these should be expected because our programs are dynamic and fast moving. If we can apply the "know how" that we have and coordinate our efforts I firmly believe we can solve most of these problems. With what is at stake we can do no less.

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