CONE AND SEED COLLECTIONS FROM SEED ORCHARDS

R. C. Kellison
North Carolina State University, Raleigh, N.C.

Establishment of seed orchards in the N.C. State Cooperative Tree Improvement Program began in 1958. In 1966, when the oldest orchards were coming into commercial seed production, we were well on the way toward the 3,000 acres of orchard that exist within the Cooperative today. The 1966 cone and seed crop was meager by comparison to later crops but it was large enough to concern seed orchard managers as to how the cones and/or the seeds of the future were to be harvested. That concern, which has been a constant companion ever since, was the reason for formation of a Seed Harvest Committee, consisting of the Advisory Committee member from six organizations within the Cooperative. This report is primarily the saga of the actions of that Committee.

IN THE BEGINNING--

About 1966, the shock-wave tree shakers, which had been successfully used for years in harvesting pecans and other nut crops, were discovered as being effective in harvesting the cones from pine trees. The cones of longleaf were reported to come rolling off like apples and those of slash pine were only a bit more tenacious. Everyone knew that Nature or somebody had forgotten to insert an abscission zone in the peduncle of loblolly pine cones1/ but that was not reason for concern. The human element reasoned that a change in the frequency or forcefulness of the shaker would loosen those burrs. Exhibitions were arranged by equipment salesmen and others. Engines were revved and things began falling. First it was dead needles, branches and cones, then came live needles--and branches including the top of the tree. Oh yeah! The cones, both yearling and mature, were on the ground--the majority still attache to the limbs. So endeth the first day.

The second day was more diverse. Man decided that Nature was remis for not inserting the abscission layer so he set out to do her one better. Ascorbic acid and other abscissants were slopped on the penduncles of loblolly pine cones over an entire season. Those cones could have cared less. At year's end they were just as persistent as their brethern that had never seen a drop of ascorbic acid.

L/ Other pines of the region having persistent cones are Virginia, shortleaf, pond, pitch, spruce, sand and table mountain. However, this account will deal solely with loblolly because of the greater relative importance of the species to the region.

Realizing that the induction of an abscission zone might be farfetched, all eggs were not put in one basket. Thoughts were entertained of using gas-filled ballons to bring the collector into contact with the cones in the tree and to train monkeys to shinny up the trees to collect the cones. Good ideas all, but for practical reasons they did not progress beyond the entertainment stage. Dusk descendeth on the second day.

The third day dawned with progress being made on another front. Various types of lifts, ladders, and scaffolding were investigated getting the collector into the general area of the crown where those tenacious cones clung. Although a number of systems have been more or less successful for local conditions, the "cherry-picker" was the overall choice then as it is today. Concommittant with the search for a system to get the orchard manager to tree-top level was an evaluation of tools and methods to excise the cones. The almost sessile nature of loblolly pine cones makes the peduncle difficult to sever so the practice then, and to some extent today, was to rip, tear, or twist the cones from the limbs. Many seed orchard managers were not happy with this system because the tips of the limbs bearing the conelets for the following year's crop and the flowers for the seed crop two years hence, were broken off at the pont of attachment of the cone being harvested. Even when the limb remains intact, an ugly scar often resulted offering a prime court for infection by insects and diseases. To prevent breakage or scarring of the limb, use was made of pneumatic and electric clippers which severs the cone flush with the limb to which it is attached regardless of whether the cut is made through the peduncle or through the basal scales of the cone where few viable seeds exist. Another measure used to good advantage was needle-nosed hand pruning shears which can be inserted between the cone and the limb to sever the peduncle. These two systems are still very much in vogue, as they were when the shutters on the third day were drawn.

The fourth day opened amid wild guffaws from those not familiar with the problem of harvesting loblolly seeds from seed orchards. The reason for the guffaws was the proposal by the Seed Harvest Committee that seeds from orchard trees having persistent cones be harvested after they had dispersed from the tree-ripened cones. The logic behind that major decision was based on the logistics of collecting cones from orchards that extend to 400 acres with possible inclusicn of 40,000 trees. Assuming, optimistically, that one man could harvest 10 trees a day, 4,000 man-days would be required to put the cones on the ground. Commensurate man-days would be required to sack the cones and transport them to the seed extractory. Mind you, all of this would have to be done in little more than a fortnight,

from the time the cones mature until natural seed dispersal2/. The sheer magnitude of cone harvesting was experienced by Weyerhaeuser Company in North Carolina in 1969. Collecting about 1800 bushels of cones from their 250 acres of orchard--about one-fourth of the anticipated crop when the orchard is fully productive--they worked 56 straight days with an average crew of 10 men. Other cooperators have had similar experiences. They need no convincing that seed harvesting will have to be by the recovery of loose seeds, not by the collection of cones from standing trees.

Methods evaluated for collecting loose seeds include the spreading of polyethlene and saran cloth on the ground, the placing of cotton polypropolene netting on a wire frame supported by posts immediately below the crown canopy, the enveloping of individual crowns by cotton polypropolene netting, and by various funnel-type frames covered with polyethlene. The most intriguing of the funnel frames was the "Japanese Fan" fashioned by the Virginia Division of Forestry. When unfolding the polyethlene-covered wooden ribs which were attached to a central hub, the contraption looked for the world like its namesake. Intriguing though it was, the Oriental job, as well as the other funnel-type frames was ineffective; about 90 percent of the seeds landed well beyond the periphery of the 25-foot diameter catchments. Success was not much better with the ground cover catchments, the base-of-crown catchments and the envelopes. Rarely was more than 50 percent of the available tree-borne seed recovered. Major reasons for the low recovery by system were:

1. Envelopes--Although common to all systems to some extent, seed dissemination was much reduced because the limbs, and therefore the cones, were somewhat bound by the covering canopy. Tests revealed that natural shed of full seeds from unmolested trees extends from early November to mid-March or even later. It was concluded that a majority of the full seeds of trussed trees remained captured in the cones.

2. Base-of-crown catchments--Wind and rain were the primary causes of failure of this system. Rain softened the ground, causing the posts to which the wire frames were attached to give, thereby allowing the netting to split and sag. Wind caused the netting to split and tear, often as the result of falling debris from the tree's crowns. More durable netting could correct the damage caused by the wind, but the cost of a higher quality netting,

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2/ The cone collection season can be extended three weeks on the front end by collecting and ripening green cones. It can also be extended by about two weeks on the late end of the season by irrigating during times of drough and by the occurrence of rain and high humidity immediately following maturity.

poor seed yields and associated problems tend to delete this system of seed collection from consideration. However, a plus factor for this system was that depredation of the seeds by birds and insects was minimal.

3. Ground-cover catchments--Seed yields obtained from this type of collection were particularly low, due partly to poor dissemination, but also to high depredation by birds and rodents. Additionally, wind blew the seeds completely off the covers despite barriers built into the edge of the covers. In summary, the catchment systems of seed collection were not satisfactory. This is not to say that other systems or modifications of the systems were used are doomed to failure. But, it does mean that additional testing is essential. While we were contemplating the additional testing the birds ceased their singing and we folded our fans, closing the fourth day.

The fifth day was devoted to the collection of seed from the orchard floor. One method proposed was to flood the orchard, allowing the winged seeds to float down a series of canals to a catchment basin where they would be recovered. That idea dies "a-wanting" because someone had failed to realize that the wing separates from the seed upon wetting and that most viable seeds of loblolly pine sink in water. The second idea of picking up seeds from the orchard floor by a vacuum sweeper appeared to some people to be even more far-fetched, but that idea still holds promise.

We have gone through two prototypes of the vacuum sweeper with optimism, fears which turned into realities, anxieties, and dedication which has been little recognized, and we still do not have an operable machine. However, we do have an arsenal of facts, figures, and observable opinions that could not have been obtained in any way other than by our association with the vacuum harvesters. For example, we know that seed dissemination from the earliest ripening clone in a given seed orchard occurs up to two months before that of the latest ripening clone. We know that the seeds do land within the confines of the orchard instead of sailing off into the "wild blue yonder" as was initimated by some antagonists. We know that, before every pass, the sweeper must be preceded by a tree shaker to get the seeds on the ground--the "S-S" system--and that 75 to 80 percent of the full seeds in an orchard can be recovered without loss of viability by four sweeping at approximately weekly intervals, beginning in early November. We also know that we can get about 99 parts of foreign substances, including bugs, pine needles, cone scales, soil particles, gravel and more bugs to one part seed with every sweeping of an orchard that has been precleaned to the best of our ability. The foreign material is a nuisance, but it is not an insurmountable problem since the majority of it can be separated from the seeds at the extractory. However, this

nuisance plus other associated developmental and operational problems were relegating the vacuum system to a back corner when the lightning bugs emerged to a signal the end of the fifth day.

The sixth day opens to an aura of high optimism. Recent advances in technology have permitted the successful development of a mechanical machine which will harvest paper shell pecans with a minimum of damage. Now, Bowie Industries, Inc. of Bowie, Texas gives us reasonable assurance that with modifications the pecan harvester can be converted to a pine seed harvester. We have entered into an agreement with them to test component parts of the machine and run preliminary field trials this fall. If all goes as anticipated, we could have an operational seed harvester by Fall, 1973, or if additional testing is needed beyond the forthcoming harvesting season, the availability of the production model will be delayed until Fall, 1974.

Preliminary tests of the mechanical harvester, which effects pick-up by the sweeping action of a rotating drum with a myriad of attached rubber fingers, have been very promising. Pick-up has been good, and separation of debris from the seeds has been better than we dared hope. The big question remaining is, "What, if any, damage is being done to the seeds?" If seed damage is encountered, the first step will be to correct the problem and if that fails, to revert to the proven system of harvesting by vacuum. (Bowie Industries has contracted to build us an operable machine regardless of the principle used.) There are some very valid reasons for favoring the mechanical over the vacuum system. Foremost among the reasons is that developmental costs and anticipated sales price of the mechanical machine will be only about one-quarter and one-half, respectively, of those of the vacuum harvester. Secondly, all parts for the mechanical harvester are readily available from existing parts suppliers; none of the parts will be custom made as would be the case with the vacuum system.

By the end of the current harvesting season, we anticipate being able to tell you that we have seen the light, that our own little world of perfecting a seed harvester has been accomplished in six days. Like that other story with which you are familiar, successful completion of the project should allow the seventh day to be one of rest. However, we are not that optimistic. Someone will likely come along to sin against the system, giving us cause to do battle with yet another crisis.