A COST STUDY OF WHITE PINE SEED ORCHARD MANAGEMENT

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The State of Ohio's nurseries currently ship 3.5 million white pine seedlings, representing 60% of the total sales. Sales of this species are expected to increase due to an accelerated reforestation program by Mead Paper and lands being idled through CRP. The Division of Forestry's desire is to produce nursery stock of the best genetic quality possible. Production at this level requires that over 300 lbs. of seed be procured every year. Clonal and seedling orchards, established by the Ohio Agricultural Research and Development Center (OARDC) in the sixties, have been turned over to the Division to manage for production of seed to help meet this need. The Division's goal for the seed orchards will be to produce seed from improved sources at a cost equal to its value on the open market. To determine the value, we will include cost of orchard maintenance, collection, extraction and storage. No attempt will be made to determine nor recover the cost of the ortet selection process prior to orchard's establishment.

PROGRAM BACKGROUND

The Ohio Division of Forestry has long been aware of the need to incorporate the potential of genetic improvement of forest trees into it's reforestation program. The lack of a definite tree improvement program (thus proper direction) in the past has resulted in good intentions but little to show for the Division's efforts. Early in 1984, the Division and the OARDC executed a memorandum of understanding which formalized the cooperative relationship between the two institutions in relation to tree improvement efforts, setting the patchwork for future accomplishments. Therefore, many of the accomplishments of the Division's tree improvement program are, in a large part, shared with the OARDC as the Division of Forestry "inherited" several of the OARDC's studies in midstream. The Ohio tree improvement program's white pine program is solidly based upon OARDC studies. In September 1984, an assistant staff forester position was assigned full-time to the post of coordinating all the Division's tree improvement efforts.

The Ohio's tree improvement program currently has accessed 81 selections of white pine, 21 coming from native stands and 60 from plantations. 75% of these were made by Kriebel and all of these selections have been propagated and outplanted into clone banks and/or seed orchards.

A large percentage of Ohio's tree improvement time and budget is devoted to the establishment and management of seed orchards. The Division is currently maintaining 8 seed orchards totaling 29 acres in area. Four of those seed orchards managed by the Division are white pine orchards. They were established in 1963, 1966, 1970, 1984, respectively with a total of area of 15.4 acres, 10.5 acres of clonal orchards and 4.9 acres of seedling seed orchard. The total production potential of these orchards is 732 bushels of cones. This production will increase in time due to the young age of these orchards.

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YEARLY MAINTENANCE PROGRAM

Maintenance of OARDC's plantings began in the spring of 1985 and the first seed crop was realized in the summer of 1986. Techniques were adopted from research or borrowed from the Southern yellow pine orchards. The yearly program the Division put together is summarized in Table I. Notice the right half of the spreadsheet. This is the cost of the tree improvement personnel working out of Zanesville. We do not have the luxury of orchards at a central location. OARDC's planting were scattered over three sites separated by hundreds of miles. This will decrease our efficiency as equipment and manpower will either be duplicated or hauled from site to site, but will be a cost to live with until second generation orchards can be established at one site.

Insect control is critical in seed orchard management as these pests can destroy 90% of a cone crop, even in good crop years. Our only serious problem is Conophthorus coniperda, white pine cone beetle. Furidan is labelled for cone beetle in Ohio, and has offered adequate protection until this year, when we lost 60% of our cone crop at two orchards within three weeks of harvest. Application is made in March with a four foot wide Gandy nursery spreader, laying down the granular in the dripline of the trees. The chemical is immediately disked in to prevent pickup of the granular by birds.

Fertilization to promote flowering occurs twice yearly, based on published research by Schmidtling (1983). The equipment and technique are similar to that used for furidan application. One application is made in late May for to promote male flowers, and a second in late June to encourage the formation of female flowers.

Cone inventories are made five times in the life cycle of the cone, starting in June. This system is based on the technique published by Bramlett and Godbee (1982). The data processing has been adopted by us to "Lotus" on a PC. Developed for yellow pines in the South, we are learning through trial and error to adjust the timing of inspection to maximize view of female flowers in the spring as well as pick up late insect attacks in the last month prior to seed collection. The information extrapolated from these data collections is invaluable to the orchard manager. Cone crop size can be predicted, variations in yield by clone discoverd and the actual cause for flower/cone loss can be ascertained.

Mowing is generally scheduled prior to activities such as fertilization or seed collecting where tall ground cover would interfere. A late fall mowing is always scheduled, however, to reduce fuel for spring fires and to reduce travel lanes for rodents.

Seed scouting is done in late July to make the final go/no go decision on harvest and to pinpoint cone maturity to facilitate the scheduling of equipment and manpower for harvest. Cones are cut longitudinally down the axis to assess the number of filled seed. In addition, cones are floated to determine the specific gravity as per the paper written by Barnett (1979).

SEED COLLECTION

Clones have been grouped, based on previous observation, into early, mid and late cone maturation groupings. Harvest can begin when the specific gravity reaches .96. Cones are stripped from the branch ends and dropped to the ground by personnel in aerial lifts and are gathered up by employees below. A one man bucket truck with three people on the ground can collect 20 bushels per eight hour day during a good seed year. Wherever possible pruning, thinning or rogueing is scheduled to coincide with harvest to increase efficiency. As with any new program, obtaining new equipment is the biggest problem. Because the Division did not own aerial lift trucks, we were forced to lease the trucks at a premium price of $800 per week. Although we collected only 5 days, we had to pay for 10. This single factor is why we harvested at a "loss" in 1986. Since then, the division has acquired a bucket truck to reduce this cost.

EXTRACTION

Cones were -trucked to the nursery's extractory in burlap sacks where they were stored in the shipping cooler until they after-ripen as per the published report by Bonner (1986). When the moisture content of the cones dictates, they were placed on racks to air dry. The cones were left to air dry for up to 14 days until moisture content is below 60%, then ran into a small kiln for 4 to 8 hours to finish the drying. Once the cones opened, they were tumbled to remove the seed. The seed was then scalped to remove cone parts and large trash, dewinged and ran through a screen cleaner. Moisture content of the cleaned seed was measured and the seed redried if the moisture content was higher than 10%. If the resulting seed lot is large enough, it is sized for the convenience of the nurserymen. Our nurseries cannot efficiently sow less than 25 lbs. of seed, so we do not size any lots less than 80 to 90 pounds. Dried lots were then stored at 28 degrees Fahrenheit. The Division tries to keep at least a 5 year supply of seed on hand, to insure nursery production during lean seed crop years.

SUMMARY

Although first generation white pine seed is occasionally available on the open market at $60.00 per pound, the Division intends to take advantage of Kriebel's research. The progeny from his orchards show the potential for 10-30% genetic gain, mostly selected from trees native to Ohio. With the recent addition of equipment, and the adoption of techniques from research and southern orchards, the Division feels it can economically manage established orchards for the production of seed. Our first crop was harvested at above market cost, but we have identified areas that will lower these costs. The acquisition of our own bucket truck will lower the cost by $13.52 per pound immediately. The Division's long range plan is to have a technician in Northern Ohio, and his presence will lower orchard maintenance costs by $3.44 per pound. Finally, improved after-ripening techniques, applied to overcome the wide variation in cone maturation between clones, will raise seed recovery by 10% in the extractory and lower the cost per pound. This has already been done with cones from our other orchards. These projected cost savings are included in Table II. We are confident that future harvests will bring us quality seed from genetically superior sources at competitive prices.

LITERATURE CITED

Barnett, J.P. 1979. An easy way to measure cone specific gravity. USFS State and Private Proceedings: Seed Collection Workshop, May 16-18, 1979, pps. 21-23.

Bonner, F.T. 1986. Cone storage and seed quality in Eastern White Pine. USFS Tree Planter's Notes, Fall 86, pg. 3-6.

Bramlett, D.L. and J. F. Godbee. 1982. Inventory-monitoring system for Southern pine seed orchards. Georgia Forest Research Paper #28.

Schmidtling, R.C. 1983. Fertilizer timing to increase flowering in Eastern White Pine. Third North Central Tree Improvement Conference, pg. 184.

Table I. MOHCAN SEED ORCHARD COST SUMMARY, 1986

COMPLET. DATE	ACTIVITY	COST: LABOR	TOTAL MAN/HRS	COST: EQUIP.	EQUIP. HOURS	TOTAL MILES	COST: ADMIN.	TTL.FOREST COST	COST: MATERIAL	T.I.COST PER.SERV	T.I.COST TRAVEL	TOTAL TI COST	TOTAL COST	TOTAL PER AC.	COST PER BUSHEL
3/27/86	apply furidan	$50.18	5	$31.60	4.0	18	$2.07	$83.85	$249.00			$249.00	$332.85	$110.95	$3.17
5/20/86	fertilize,male	$45.80	4	$31.60	2.0	18	$2.07	$79.47	$15.93			$15.93	$95.40	$31.80	$0.91
5/20/86	cone inv.	$46.86	3	$5.40		163	$3.91	$56.17		$71.53	$22.66	$94.18	$150.35	$50.12	$1.43
6/13/86	mow	$38.76	4	$28.82	2.2		$5.16	$72.74				$0.00	$72.74	$24.25	$0.69
6/20/86	fertilize,fema	$45.20	4	$31.60	1.8	18	$3.91	$80.71	$15.31			$15.31	$96.02	$32.01	$0.91
7/3/86	cone inv.	$26.16	3	$72.00		163	$2.58	$100.74		$71.53	$22.66	$94.18	$194.92	$64.97	$1.86
7/9/86	seed scouting	$26.16	3	$5.40		18	$2.58	$34.14		$71.53	$22.66	$94.18	$128.32	$42.77	$1.22
10/22/86	cone inv.	$26.16	3	$72.00		163	$2.58	$100.74		$71.53	$22.66	$94.18	$194.92	$64.97	$1.86
11/19/86	mow	$38.76	4	$28.82	2.2		$2.58	$70.16				$0.00	$70.16	$23.39	$0.67
	TOTALS	$344.04	33.0	$307.24	12.2	561.0	$27.44	$678.72	$280.24	$286.10	$90.63	$656.97	$1,335.69	$445.23	$12.72
	% FOREST COST	50.7%		45.3%			4.0%	100%							
	% TOTAL COST	25.8%		23.0%			2.1%		21.0%	21.4%	6.8%		100%		
SEED COLLECTION															
8/1 TO 5	COLLECTION	$1,505.40	242	$1,682.99		96		$3,188.39		$357.63	$113.29	$470.92	$3,659.31	$1,219.77	$34.85
												TOTAL BU. COLLECTED		105	
SEED EXTRACTION															
AIR DRY(LOAD TRAYS)		$31.84	4	$0.00											
KILN DRYING		$15.92	2	$168.00	24								31.84		$0.30
CONE TUMBLING		$63.68	8	$0.00									183.92		$1.75
SCALPER/DEWING		$15.92	2	$0.00									63.68		$0.61
CLEANER		$31.84	4	$0.00									15.92		$0.15
SIZER		$15.92	2	$0.00									31.84		$0.30
													15.92		$0.15
		$175.12	22	$168.00	24								$327.20		$3.12
															$53.96
												TOTAL COST OF SEED			$87.02

Table II. MOHCAN SEED ORCHARD COST PROJECTION WITH TRUCK, LOCAL TECHNICIAN

COMPLET. DATE	ACTIVITY	COST: LABOR	TOTAL MAN/HRS	COST: EQUIP.	EQUIP. HOURS	TOTAL MILES	COST: ADMIN.	TTL.FOREST COST	COST: MATERIAL	T.I.COST PER.SERV	T.I.COST TRAVEL	TOTAL TI COST	TOTAL COST	TOTAL PER AC.	COST PER BUSHEL
3/27/86	apply furidan	$50.18	5	$31.60	4.0	18	$2.07	$83.85	$249.00			$249.00	$332.85	$110.95	$3.17
5/20/86	fertilize,male	$45.80	4	$31.60	2.0	18	$2.07	$79.47	$15.93			$15.93	$95.40	$31.80	$0.91
5/20/86	cone inv.	$24.00	3	$36.00		18	$3.91	$63.91				$0.00	$63.91	$21.30	$0.61
6/13/86	mow	$38.76	4	$28.82	2.2		$5.16	$72.74				$0.00	$72.74	$24.25	$0.69
6/20/86	fertilize,fema	$45.20	4	$31.60	1.8	18	$3.91	$80.71	$15.31			$15.31	$96.02	$32.01	$0.91
7/3/86	cone inv.	$24.00	3	$36.00		18	$2.58	$62.58		$71.53	$22.66	$94.18	$156.76	$52.25	$1.49
7/9/86	seed scouting	$26.16	3	$5.40		18	$2.58	$34.14				$0.00	$34.14	$11.38	$0.33
10/22/86	cone inv.	$24.00	3	$36.00		18	$2.58	$62.58				$0.00	$62.58	$20.86	$0.60
11/19/86	mow	$38.76	4	$28.82	2.2		$2.58	$70.16				$0.00	$70.16	$23.39	$0.67
	TOTALS	$316.86	33.0	$265.84	12.2	126.0	$27.44	$610.14	$280.24	$71.53	$22.66	$374.42	$984.56	$328.19	$9.38
	% FOREST COST	51.9%		43.6%			4.5%	100%							
	% TOTAL COST	32.2%		27.0%			2.8%		28.5%	7.3%	2.3%		100%		
SEED COLLECTION															
8/1 TO 5	COLLECTION	$1,505.40	242	$262.99		96		$1,768.39		$357.63	$113.29	$470.92	$2,239.31	$746.44	$21.33
SEED EXTRACTION															
AIR DRY(LOAD TRAYS)		$31.84	4	$0.00									31.84		$0.30
KILN DRYING		$15.92	2	$168.00	24								183.92		$1.75
CONE TUMBLING		$63.68	8	$0.00									63.68		$0.61
SCALPER/DEWING		$15.92	2	$0.00									15.92		$0.15
CLEANER		$31.84	4	$0.00									31.84		$0.30
SIZER		$15.92	2	$0.00									15.92		$0.15
		$175.12	22	$168.00	24								$327.20		$3.12
															$37.09
													TOTAL BU. COLLECTED		105
													TOTAL COST OF SEED		$56.50