PN-ACE-497
ISN 21

PAKISTAN TREE SEED CENTER REPORT

Franklin T. Bonner
USDA Forest Service

Consultancy sponsored by

USDA Forest Service and the
Forestry/Fuelwood Research and Development (F/FRED) Project

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October 21, 1988

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I. Introduction

The purpose of this consultancy was to assist the Pakistan Forest Institute (PFI) in Peshawar in the establishment of a national tree seed center. This activity is part of the F/FRED Project, under contract to Winrock International Institute for Agricultural Development. The specific objectives were to:

(1) review the existing tree seed program and estimate future needs for tree seeds in Pakistan;

(2) recommend equipment required to meet the seed program needs, through collection, processing, storage, and testing;

(3) evaluate the physical plant at PFI in terms of seed program needs and identify additional space requirements;

(4) prepare a management plan for operation of the seed facility, including staff organization, staff training, technical direction, and maintenance.

At the request of the Inspector General of Foresty, a section has also been included on the types of applied seed research that will be appropriate in the Center's operation.

I arrived in Peshawar on Sept. 3, 1988, and left Islamabad on Sept. 23. All of my time was spent in Peshawar, except for a three-day trip to Abbotabad, Mansehra, Muzaffarabad, and Muree (Sept. 12-14), and a two-day exit conference in Islamabad on Sept. 21-22. My primary contacts at PFI were Mr. M.I. Sheikh (Director General, PFI), Dr. K.M. Siddiqui, and Dr. Shams-ur-Rehman. The primary input was from Dr. Rehman, a geneticist, who had prepared a lengthy proposal to the government of Pakistan for a seed center and tissue culture laboratory. I also met briefly with Albert Merkle (USAID) and Ken McNabb (Winrock Int.). In Islamabad I met with Dr. Gene Ostmark (Winrock Int.), Mr. Hameedullah (USAID), and Mr. Abeedullah Jan, Inspector General of Forestry, Pakistan.

II. National Tree Seed Program

A. Scope

Reforestation and afforestation needs in Pakistan are considerable, and a strong, technically competent, and well-organized tree seed center would help meet these needs. In many countries, one of the greatest obstacles to meeting planting goals is the lack of high-quality seeds of the desired species. A major step in removal of this obstacle would be the establishment of a National Tree Seed Center. The Center should have the following functions:

(1) collect, clean, test, store, and distribute tree seeds for seedling production in Pakistan (**TOP PRIORITY!**);
(2) provide seed testing services for other forestry projects and groups (donor agencies, NGO's, etc.) in Pakistan;
(3) operate as a seed bank for international exchange of tree seed samples with other countries;
(4) store valuable tree germplasm as part of a national program for conservation of genetic resources;
(5) serve as focal point for tree seed research in Pakistan through PFI staff and facilities.

B. Seed Requirements

Based on information supplied by Dr. Shams-ur-Rehman of PFI, the species listed in Table 1 will form the majority of the seed activities for this project. The estimated amounts for 1988 are based on proportional projections of the 1988 seedling production goals for the entire country. These quantities are for well-cleaned (high purity), high-quality seeds. There will be small amounts of other species, of course, and priorities may change over time. The estimates in Table 1 do not include the seed requirements for Azad Kashmir, because these will be handled separately by the new Center at Garhi Dopatta.

It should also be noted that these goals are not being met currently, because of irregular seed crops, a shortage of trained collectors, and a lack of seed cleaning and storage facilities. Within the next five years the proposed Seed Center at PFI should solve the last two problems. Once the Seed Center is in full operation, the annual seed requirements should increase some each year.

C. Organization

The Tree Seed Center will be located in Peshawar at PFI. A seed testing laboratory and a cold storage facility should be part of the Center. For extraction and cleaning of the collections, two options are presented:

Option A - all cleaning, testing, and storage to be done at PFI; collection centers in Sind and Punjab (one each) for concentration of provincial collections and extraction of seeds from fruits; partially cleaned lots to be shipped to PFI for final cleaning, testing and storage; all NWFP activities at PFI; seeds to be shipped to nurseries from PFI storage on demand.

Option B - Sind and Punjab centers to extract and clean their province's collections, shipping only test samples and excess of easily stored species back to PFI for storage; next year's nursery lots to remain in the provinces; all recalcitrant seeds to go back to PFI for storage; all NWFP activities at PFI.

Two options are provided because there is some question about the willingness of provincial forestry staffs to ship their entire collections back to PFI for storage of only a few months. The Inspector General also pointed out that transportation of this amount of seeds would be quite expensive. The advantages of Option A are: (1) better storage conditions for all seeds; (2) less equipment purchases; (3) more likely to have proper sampling and testing; (4) less chances of error in seed inventory records; (5) easier international exchange of seed samples. Advantages of Option B are: (1) transportation costs greatly reduced; (2) seed supplies are closer to the nurseries; (3) better cooperation with the provincial forestry staffs; (4) annual cold storage space requirements will be much less at PFI, thus allowing more long-term storage for future years.

Under either option, seed needs for Baluchistan, which are rather small, could be met at the Sind Center or at PFI. Azad Kashmir seed needs will be met through the Center at Garhi Dopatta. And no matter which option is chosen, organization of seed collections will remain essentially the same. Pakistan forestry officials should make the choice, as well as choosing the sites for the collection centers in Sind and Punjab.

III. Seed Collection

A. Organization

Most seed collections will continue to be made by PFI and provincial forestry department personnel. As the Seed Center achieves full operation, collection teams (as many as six 2-man teams) should assist provincial personnel in collection and train them to improve their collection practices. Each PFI collection team should be provided with good tools for collecting seeds from small to medium-sized trees (30-40 feet tall). Three teams should be equipped with climbing gear for climbing large trees. While most collection climbing will probably still be done by local people in the provinces, PFI will need their own teams for special collections, such as cones/fruits from plus-tree selections in improvement programs.

Table 1.- Primary seed requirements for Pakistan in 1988.

Species	Maturity/ collection dates	Approximate cleaned seeds/kg	Estimated amounts(kg) for 1988
Acacia nilotica	June	7,000	2,800
Aesculus indica	Oct/Nov	100	AK*
Ailanthus altissima	May/June	40,000	500
Albizia procera	Feb/May	33,000	200
Azadirachta indica	July/Aug	5,000	500
Bombax ceiba	April/May	43,000	1,000
Casuarina equisetifolia	March	825,000	5
Cedrus deodara	Oct/Nov	8,100	500
Dalbergia sissoo	Jan/March	40,000	1,200
Eucalyptus camaldulensis	Aug/Sept	4 mil	100
Juglans regia	Sept/Oct	100	AK*
Leucaena leucocephala	July	26,000	100
Melia azedarach	January	1,200	800
Morus alba	April/May	520,000	15
Pinus roxburghii	April	12,300	1,500
P. wallichiana	Oct/Nov	26,000	1,000
Populus euphratica	June	6.5 mil	2
Prosopis cineraria	June	31,000	500
Prunus padus	October	19,600	AK*
Robinia pseudoacacia	Sept	52,800	500
Total			11,222

*AK - primarily for Azad Kashmir; handled at Garhi Dopatta.

B. Equipment

Item	Estimated Cost US$
Climbing spurs, belts, ropes, snaps, and replacement parts (6 sets)	1,800
High-limb flexible saws (12)	240
Telescoping fiberglass tree pruners (6)	300
Aluminum sectional ladders, 10-ft sections (10 sections)	1,500
Cone knives\cutters (2)	86
Lopping shears (6); hand shears (6)	350
Total	4,276

(Specifications are given in the Appendix.)

III. Extraction and Cleaning

A. General

The PFI Seed Center will receive fruits, partially cleaned seeds, and some fully cleaned seeds from both provincial seed collection centers and from PFI collection crews. All incoming lots will be assigned a lot identification number that will remain the same throughout the life of that lot. Following extraction, seeds will be cleaned, dewinged (if necessary), and upgraded (removal of empty, damaged, and immature seeds). For most species a purity of 95% will be the goal. Success in upgrading will vary widely by species, but should range from 90% successful in pines and most legumes to 10% successful in Eucalyptus. Table 2 gives a suggested flow chart of seed processing for the species under consideration, including which types of equipment should be successful in each step. Table 3 gives approximate screen sizes for cleaning seeds of Table 1 on the air-screen cleaners.

B. Physical Plant

There is no suitable place in existing PFI facilities at Peshawar for the extraction and cleaning equipment. A site across the road from PFI in the range research area was identified as a tentative location for this equipment. Electrical

TABLE 2 Suggested Seed Processing Steps

FRUIT TYPE	SPECIES	DRYING	EXTRACTION	CLEANING	DEWINGING	UPGRADING
Legume	Acacia Albizzia Dalbergia Leucaena Prosopis Robinia	full sun on racks or tarps	macerator	air-screen cleaners	N/A	seed aspirators
Cone	Pinus Cedrus	full or partial sun on racks	cone tumbler, cement mixer	air-screen cleaners	cement mixer, macerator	seed aspirators
Cone-like	Casuarina	full sun on racks	cone tumbler	air-screen cleaner	N/A	seed aspirators
Dry, multi-seed fruit	Bombax Eucalyptus	full sun on racks or tarps	macerator cone tumbler	air-screen cleaner seed blower	N/A N/A	N/A N/A
Dry, single seed fruit	Aesculus Ailanthus Juglans	do not dry! full sun on racks N/A	N/A N/A macerator	N/A seed aspirator screen or water flotation	N/A macerator N/A	water floation N/A
Berries or drupes	Azaderacta Melia Morus Prunus	do not dry!	macerator, with water	water flotation during macerator	N/A	water flotation for Morus and Prunus

TABLE 3 - Approximate screen sizes for cleaning on air-screen cleaners (both models). Source and seed year variations in size will necessitate some changes.

Species	Scalping (top screen)	Cleaning (bottom screen)
Acacia nilotica	20 R	13 - 14 R
Albizia procera	15 - 16 R	9 R
Bombax ceiba	14 - 15 R	9 R
Casuarina equisetifolia	8 - 9 R	1/12 R
Cedrus deodara	14 X 3/4 0	8 X 3/4 0; 16 R
Dalbergia sissoo (seed in pod pieces)	14 X 3/4 0	18 R
" " (seed completely extracted)	14 R	8 R
Leucaena leucocephala	16 R	9 R
Pinus roxburghii	22 R	14 R
P. wallichiana	18 R	11 R
Prosopis cineraria	13 R	9 R
Robinia pseudoacacia	11 R	5½ R

Code: R = round hole screen; 0 = oblong hole screen

power and an access road are present on the site. A space of about 50 X 100 ft. will be needed to contain drying racks and an open-sided pole shed to house the extraction and cleaning equipment. Fill dirt will have to be moved in to raise the ground level about 3 feet. This shed should be approximately 30 X 60 ft. in area and have a concrete slab floor (gently sloped to drain at one end), 10 to 12 ft. overhead clearance, pitched metal roof, and no walls. The open sides will facilitate ventilation and dust removal during cleaning operations. There should be roll-down tarps or reed mats on all four sides to allow protection during the rainy season. Suggested location of equipment within the shed is shown in Figure 1.

Other potential sites for the extraction/cleaning shed were examined, but they were rejected because of limited space or because of potential problems of dust from seed cleaning. There will be a definite advantage in having the cleaning operation so close to the testing lab and to the storage facility.

PFI will be responsible for raising the elevation of the site 3 feet and for constructing the pole shed. If funds are available, USAID should consider an allocation of $3,000 for purchase of supplies, thus enforcing the cooperative nature of this project.

C. Equipment

The equipment needs are listed according to the options for organization that were outlined previously.

Option A - Centralized cleaning at PFI

Item	Estimated cost US$
Macerators (4); 2 for PFI, 1 for Sind, 1 for Punjab	6,000
Small-lot tumbler, 3 bu. capacity	1,200
Small cement mixer, 3 cu. ft. capacity	700
Table-top Clipper cleaner, w/2 screens	1,115
Extra screens for Clipper cleaner (12)	366
Clipper M2-B cleaner, w/2 screens	2,000
Extra screens for M2-B (12)	300
Set of hand screens, 25 sizes	430
Medium-sized seed aspirators (2)	10,000

Small seed blower	1,900
Floor fan, 36 in. blade width	600
Air-blower for cleaning	425
Electric moisture meter	330
Total	25,366

Option B - Some cleaning/storage in Sind and Punjab

Item	Estimated cost US$
Macerators (4); 2 at PFI, 1 in Sind, 1 in Punjab	6,000
Small-lot tumbler, 3 bu. capacity (PFI)	1,200
Small cement mixer, 3 cu. ft. capacity (PFI)	700
Table-top Clipper air-screen cleaner, 2 screens(PFI)	1,115
Extra screens (12) for Clipper (PFI)	366
Clipper M2-B cleaners, w/2 screens (3); 1 each at PFI, Sind, and Punjab	6,000
Extra screens for M2-B: PFI(7); Sind(6); Punjab(6)	475
Set of hand screens, 25 sizes (PFI)	410
Medium-sized seed aspirators (3); 1 each at PFI, Sind, and Punjab	15,000
Small seed blower (PFI)	1,900
Floor fans, 36 in. blade width (3); 1 each in PFI, Sind, and Punjab	1,800
Air-blower cleaners (3); 1 each at PFI, Sind, and Punjab	1,275
Electric moisture meters (3); 1 each at PFI, Sind, and Punjab	990
Total	37,231

(Specifications are given in the Appendix.)

With either of the above options, equipment deployment is extremely flexible. All of it is relatively small and can be easily moved to other locations by truck. As large-scale

collection and processing becomes a reality, adjustments may become desirable to handle large amounts of a particular species, which were not anticipated in original planning.

V. Seed Testing

A. General

The Center should have the capacity to do routine tests for purity, moisture content, seed weight, and germination. In addition to in-house testing, facilities should be planned to allow for outside user testing on a fee basis. The revenue would be minimal, but it would enhance the image of the Center. Procedures of the International Seed Testing Association (ISTA) should be followed for purity, moisture content, and weight. Current ISTA Rules (1985 Edition) do not include germination prescriptions for all of the species in Table 1, but other sources have been used to compile a list of recommended germination test procedures (Table 4). There are always variations in the reactions of particular seed sources to seed pretreatments and germination conditions. As the Center gains experience in testing seeds from local sources, more suitable test methods than those in Table 4 may emerge.

B. Laboratory Space

The current Genetics Laboratory and the adjacent corner room at PFI are sufficient to house the testing equipment. The floor in the Genetics Laboratory should be leveled, and the shelves should be removed from the corner room. The latter will house the germinators, a small refrigerator, and a work table. Test set-ups can be done in either room, but counting should be done in the room with the germinators. Equipment for purity, moisture content, and weight tests should be placed in the Genetics Laboratory; these are primarily the purity board, balances, oven, and desiccators. No wall or door changes will be needed. Suggested equipment placement is shown in Figure 2.

C. Equipment

Item	Estimated cost US$
Cabinet germinators, w/trays and lights(4)	13,354
Extra trays for the above (48)	816
Plastic boxes for germination tests	
4 5/16" x 4 5/16" x 1 3/8" (200)	88
7 3/8" x 5 5/16" x 3 5/16" (96)	170
Round plastic dishes for germination tests	75

TABLE 4 - Suggested Germination Test Conditions

SPECIES	SUGGESTED PRETREATMENT	MEDIUM	TEMPERATURE (°C)	DURATION (Days)	COMMENTS
Acacia nilotica	Sc: M,A HW; CW 24 hr	S,B	20/30 *	21	
Aesculus indica	CW 48 hr, cut off 1/3 scar end	S	20/30	21	Some sources may need prechill
Ailanthus altissima	CW 24hr, remove pericarp	P,B	20/30	21	**
Albizia procera	Sc: M, HW	B	20/30	21	
Azadirachta indica	CW 24-48 hr	B,S	25	21	
Bombox ceiba	none	B	25	21	
Casuarina equisetifolia	CW 24 hr	P,B	20/30	14	
Cedrus deodara	Pc: 21 days @ 3-5°	P,B	20	21	**
Dalbergia sissoo	CW 24 hr	B	30; 20/30	21	Remove seeds from pods
Eucalyptus camaldulensis	none	P	30	14	** Test by weight (0.1 g per replicate)
Juglans regia	Pc: 30-120 days	S	20/30	40	
Leucaena leucocephala	Sc: HW(60°, 2 min),M	B	30	14	
Melia azedarach	CW 24-48 hr	S	20/30	28	
Morus alba	none; CW 24 hr	P,B	20/30	28	**
Pinus roxburghii	none	B	20/30	28	
P. wallichiana	none	B	20/30	28	**
Populus euphratica	none	P,B	20/30	10	**
Prosopis cineraria	Sc: M; CW 24 hr	B	30	21	
Prunus padus	Pc: 3-4 mo @ 3-5°	S	20/30	28	** TZ or excised embryo preferred.
Robinia pseudoacacia	Sc: M,A,HW	B	20/30	14	**

Pretreatment codes:
A = acid scarification
CW = cold water soak
HW = hot water treatment
M = mechanical sacarification
Pc = prechill
Sc = scarify

Medium codes:
B = germination blotter
P = filter paper
S = sand

* - Use 16 hr @ 20° in dark and 8 hr @ 30° in light.
** - Prescription from ISTA rules (1985).

4 1/4" diameter, 7/8" high (160)	
Germination paper, various sizes	
circular blue blotter, 4 1/8" (2M)	130
white filter paper, 3 1/2" (1M)	35
white blotter, 4 1/8" x 4 1/8" (10M)	300
white blotter, 6" x 9" (10M)	350
Stereo microscope, 10X total mag., transformer	490
Refrigerator, 12 cu. ft.	700
Sample scarifier	400
Laboratory over, forced air, 1.5 cu. ft.	850
Top-loading electronic balance	1,450
Purity work board, lighted model	82
Sample divider (Boerner type)	700
Electronic sample counter	2,200
Seed triers, 18" and 30" (2 of each)	270
Plastic desiccator cabinet, 3 shelves, 12 1/2" x 15 1/4" x 20", with 3 trays	250
Desiccant, 8-mesh, indicating (10 lb.)	90
Sample cans, aluminum, 3 1/2" diam.(3 doz.)	440
Scoops, aluminum, 24 and 48 oz. capacity	16
Forceps, tapered shanks, 4 5/8" long (10)	128
Total	23,384

(Specifications are given in the Appendix.)

VI. Seed Storage

A. General

The most important factor in prolonging storage life of seeds, by far, is seed moisture content. Low temperatures also help, but seed moisture is the primary factor. Most of the species in Table 1 are "orthodox" in storage behavior; they can be dried to moisture contents between 5 and 10% for prolonged storage at low temperatures. Seeds that will not stand

desiccation are called "recalcitrant"; they must remain at high moisture contents (20 to 40%). Among the species in Table 1 only Aesculus indica and Azadirachta indica have recalcitrant seeds. Seeds of Cedrus deodara, Juglans regia, and Populus euphratica will present some storage problems, but they are basically orthodox. Orthodox seeds will be dried to moisture contents of 6 to 10% and stored in sealed, moisture-proof containers at 1° to 3° C. for long-term storage (more than 1 year). Hard-seeded legumes, such as Acacia, Albizia, Prosopis, etc. can be stored at ambient temperatures for at least a year, when dried to the 5-10% range of seed moisture. Under Option B for collection/cleaning, therefore, these seeds can be stored at the Sind and Punjab Province locations without refrigeration until they are sown the following season. For storage beyond this period, seed quality will best be maintained in cold storage.

Any recalcitrant seed storage will only be for 2 to 3 months at the same 1° to 3° C., but with no seed drying. Containers of recalcitrant seeds must also remain partially open to allow some gas exchange with the surrounding atmosphere.

B. Physical Plant

A prefabricated cold storage facility can be placed in the combined space of rooms 27 and 28 at PFI. This will require removal of the wall between these rooms, sealing the window spaces, and sealing one door. The cooler door should be on the corridor side of this space, preferrably at one of the existing doors (approximately 7' or 11'6" from the corners). If these dimensions do not fit the prefabricated panel sizes, a new door will have to be cut in this wall. With the maximum height available in these pre-fab units of 11'6", there should be approximately 110 cu meters of storage space. Applying a very conservative rule-of-thumb of 140 kg per cu. meter, there should be room for at least 15,400 kg of seed. If most seeds are stored in 12 gal. or larger drums, there should be a space saving of about 20%, therefore adding another 3,100 kg to the capacity.

While the total of 18,500 kg is less than a 2-year's supply (Table 1), all of this amount will not be in the cooler at one time. Differing times of seed maturity and shipments to the nurseries will keep the stocks below the maximum level. Furthermore, if Option B is selected, at least half of the maximum supply in any one year will remain in Sind and Punjab for immediate use in their nurseries.

A remote-type refrigeration system should be used for this cooler. The condensing unit should be located just outside of room 27 on a concrete pad at ground level. It should be protected with a sloping metal cover and a metal mesh fence. The blower coils will be located inside the cooler. Normal operating temperature should be 2° ± 2° C. with no humidity controls. Metal or wooden shelving (preferrably wooden) will be furnished by PFI. There should be gap of 20 cm between the shelves and the walls,

and a gap of about 50 cm between the ceiling and the top storage containers. Walkways between tiers of shelving should be 90 cm (about 3 feet) wide.

Any type of rigid, moisture-proof container can be used to store seeds. The best utilization of space, however, is obtained with large containers that hold up to 25 gal. each. Many of the seed lots to be collected in Pakistan will be this large and larger. To insure integrity of the moisture barrier, polyethylene bags with a wall thickness of at least 4 mils (0.1 mm) should be used as liners in the containers, no matter what type. The most widely used containers are rigid plastic carboys and poly-lined cardboard drums (12 and 24 gal capacity).

C. Equipment and Costs

Item	Estimated cost US$
Removal of wall between rooms 27 and 28	1,500
Walk-in cooler (see Appendix for specifications)	17,000
Cardboard fiber drums: 12 gal (100)	800
Plastic bottles w/screw-top lids, 1 gal. capacity	500
Plastic pails w/sealable lids: 5 gal. (50)	295
Polyethylene bags for container liners (4-mil)	800
Total	20,895

(See specifications in the Appendix.)

VII. Operation

A. Staffing

In the operation of the Center there are four major work areas to be considered: collection, extraction/cleaning, testing, and inventory. Each of these areas should have a Research Officer (RO) in charge of its operation. Double responsibilities are possible. One RO could handle collection and extraction/cleaning, while another could handle testing and inventory. This arrangement is quite feasible in the first years of operation of the Center. With normal growth of operations, a separate RO for each work area will be needed within ten years.

The following staff organization is suggested:

Center Director (overall supervision)

Collection--- Research Officer (in charge)
12 technicians (six teams of two)

Extraction/cleaning---Research Officer (in charge)
Option A: 3 technicians at PFI; 1 at each center in Sind and Punjab.
Option B: 2 technicians at each of the three locations.
It may be possible for some of the collection technicians to fill both roles, because of the seasonal nature of collection.

Testing-------Research Officer (in charge)
1 technician for purity, moisture, and weight
1 technician for germination tests

Inventory-----Research Officer (in charge), 1 clerk

B. Training

The following are minimum training needs for the staff of the proposed Center.

1. Equipment operation--When the equipment is delivered and installed, USAID should provide a technical advisor to instruct all personnel in operation and maintenance.

2. At least two of the RO's should attend a short-term training course in tree seed technology in 1989 or 1990. The proposed 4-week course at Mississippi State University in the USA or equivalent would be best. Second choice would be the 2-week course supported by USFS/FSP and taught in various places. This course could even be taught at PFI in the future.

3. The RO in charge of seed testing should get practical training of at least 3 months at a tree seed testing center. Possibilities are: Macon, GA (USFS), Starkville, MS (USFS), CSIRO lab in Australia, or ASEAN Seed Center in Mauk Lek, Thailand.

4. When the Center is fully operational in 1990 or 91, USAID should arrange for the USFS/FSP 2-week course to be taught at PFI. Trainees would be the Center staff, Forest Rangers in charge of seed collections, and other seed cooperators in Pakistan, such as the staff of the new Garhi Dopatta seed center. (See 2 above.)

5. DANIDA should be asked to send their tree-climbing team to teach safe climbing techniques for seed collectors. This could be done in conjunction with the 2-week training course.

C. Technical Aids

There are several steps that PFI should take to maintain a good level of technical information related to tree seed technology:

(1) Once the Center is operational, PFI should seek "accredited laboratory" status in ISTA. Pakistan is currently a member of ISTA, but only the agricultural seed testing station at Lahore is accredited. Cooperation between the two laboratories should be arranged with the Ministry of Food, Agriculture and Under-developed Areas, Islamabad.

(2) PFI should increase their activities within IUFRO (International Union of Forestry Research Organizations) working groups, primarily the Project Group on Seed Problems (P2.04). The Center Director should attend the seed symposium of this IUFRO Group in Australia in Aug./ Sept., 1989.

(3) Contact with the DANIDA Seed Center in Denmark should be maintained.

(4) Additional seed technology journals and books should be acquired by the PFI Library. Some good journals are:

Seed Science and Technology
Journal of Seed Technology
New Forests
International Tree Crops Journal
Agroforestry Systems
Canadian Journal of Forestry Research
Seed Abstracts
NFTA News.

Some books that would be helpful are:

ISTA Handbooks on Vigor Testing, Tetrazolium Testing, and Tree Seed (due out in 1989)
A Guide To Forest Seed Handling, FAO Forestry Paper 20/2
Principles of Seed Science and Technology by Copeland and McDonald (new edition).

(5) A good seed inventory system must be established. Labels should be placed on all lots as they are received for cleaning, and the lot numbers should stay on those lots until the seeds are all gone. Labels should be both on

the outside of the containers and inside with the seeds. I suggest a labeling system which uses codes (numerical or character) for: species, province, district, year, and accession number (assigned in ascending order of receipt).

The labeling system should also be compatible with a computerized data base program that can store this information, plus details of collection location, all test results, amount of seed on hand, shipments to nurseries, seed treatments, etc. PFI can use its IBM micros for this purpose, either designing their own record system with dBASE-III software, or purchasing a copy of an Australian system in use by CSIRO. The Australian system, "TREESEED", is for IBM-compatibles and can be purchased for A$450.

(6) A systematic maintenance plan must be established fo all equipment in the Center and in provincial collection centers. Not only will this step prevent breakdowns, but it is necessary to maintain seed lot integrity through cleaning of extraction/cleaning equipment between lots. The technical consultant who will train the staff in use of the equipment should provide this information at that time. It is essential that this plan be followed rigidly!

VIII. Seed Research

Establishment of the Seed Center will provide an excellent opportunity for PFI to build a strong seed research program. Such a program will support the Center's work and complement current forestry education and research at PFI. Although seed research can go in many directions, it will be very important that the initial research support operations of the Center. Some suggested research priorities in tree seed technology follow.

A. Seed Maturity

Objective: To develop easily recognized seed maturity indices that reflect optimum physiological maturity and which can be used as collection guidelines.

Approach: Collections should be made every one or two weeks from the same trees as their fruits mature. Dry weight, moisture content, specific gravity, and germination can be tested in the PFI lab.

Facilities: Everything needed will be on hand.

B. Extraction/Cleaning

Objective: To develop improved exraction and cleaning techniques that will enhance seed quality.

Approach: New equipment at the Center can be used to compare such things as winnowing vs. screen cleaning; manual thrashng vs. mechanical macerators; immediate extraction vs. delayed ripening of seeds in fruits; water flotation vs. blower separation.

Facilities: Everything needed will be on hand.

C. Pretreatment Methods

Objective: To develop improved seed pretreatments that will increase nursery germination rates and thus improve the yield of plantable seedlings.

Approach: For hardseeded species, comparisons should be made of (1) mechanical scarification, (2) hot and cold water soaks (all time and temperature combinations), and (3) hot wire scarification. For other species, tests should be run on stratification times, moisture contents, and temperatures; chemical stimulation; fungicidal treatments; mycorrhizal innoculations; and osmotic priming.

Facilities: Everything needed will be on hand, except for chemicals. Minor purchases will be required.

D. Germination Testing

Objective: To develop quicker and improved methods of testing seed quality.

Approach: Traditional germination methods should be used to determine optimum temperatures, light conditions, and germination media. Since most of these species are not covered by the ISTA Rules, data must also be accumulated on seed weights, purity problems, and types of seedling abnormalities. Rapid germination estimates are often needed when time is too short for germination tests. Techniques such as tetrazolium staining, excised embryo, electrolyte leakage, and simple cutting tests should be compared.

Facilities: Only minor purchases will be required: remote

temperature sensors, a conductivity meter, and a photometer. Some of this equipment may be presently available at PFI.

E. Storage Methods

Objective: To improve retention of viability in stored seed lots.

Approach: Most species to be processed at the Center do not present storage problems. Others, such as poplars, neem, or deodar, are problem species, and different combinations of temperatures, moisture contents and containers should be tested. Samples of other species should be put in special sealed containers for longterm storage trials that will demonstrate just how long these species can be stored under proper conditions. These data will have great importance for germplasm conservation programs.

Facilities: Everything needed will be on hand.

F. Future Research

As the Center develops expertise in seed science, related studies can be incorporated into the research program. These studies might well be cooperative research with biochemists, pathologists, entomologists, cytologists, etc. at PFI and other institutions.

IX. Cost Estimate

Activity	Option A	Option B
Collection	$4,276	$4,276
Extraction/Cleaning	25,366	37,231
Testing	23,384	23,384
Seed Storage	20,895	20,895
Total	$73,921	$85,786
Freight, etc. (30%)	22,176	25,736
	$96,097	$111,522

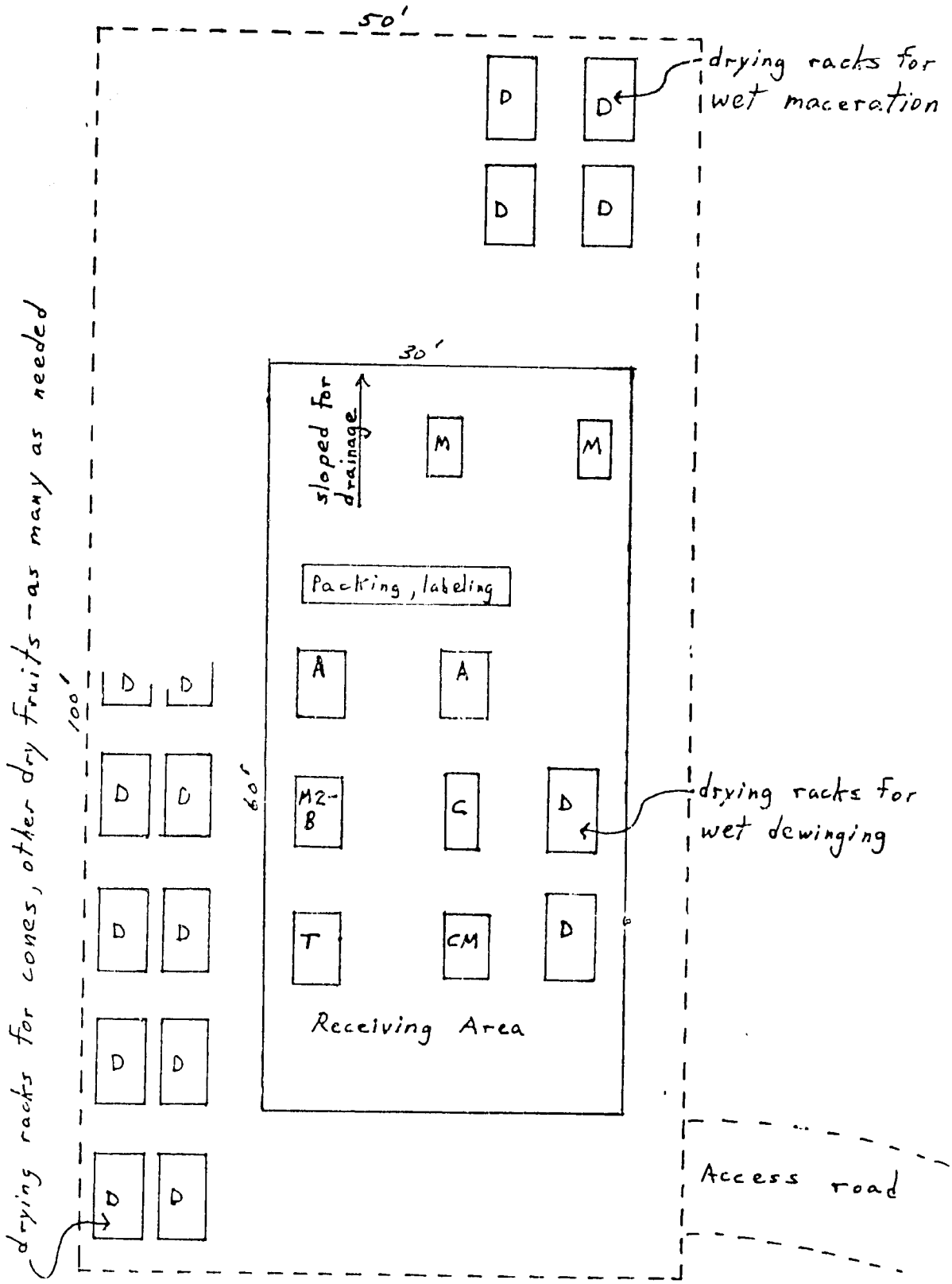

Figure 1 - Suggested facilities arrangement for seed extraction and cleaning at PFI.

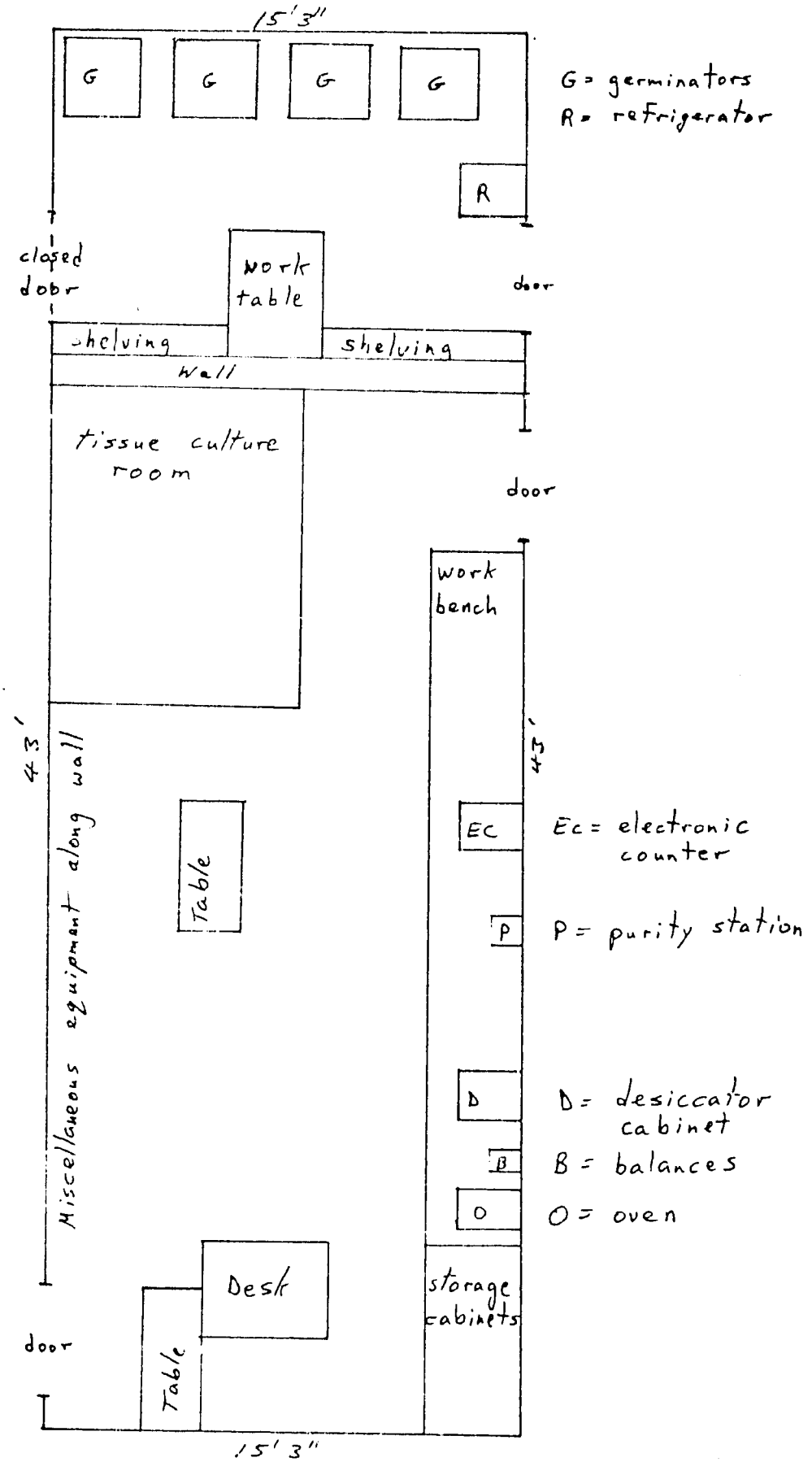

Figure 2 - Suggested equipment placement in the seed testing laboratory. (1 cm=2 ft).

APPENDIX

Equipment Specifications

Collection

(1) Climbing spurs, 2 3/4" replaceable gaffs, adjustable in 1/4" increments from 15" to 19"; W/ climbing pads, two 22" leather calf straps and two 26" leather ankle straps. Equal to Cat. # 27190. Forestry Suppliers, Inc. (6 sets)

(2) Replacement parts for above: leather leg pads (left and right) leather calf straps, 22" long; leather ankle straps, 26"long; tree gaffs, 2 3/4" long (pair). Equal to Cat. # 27140, 27141, 27142, and 27201, Forestry Supplier's, Inc. (6 sets)

(3) Tree trimmer's belt, nylon webbing; belt and seat pads; 4 drop-forged circle D-rings, 2 on seat belt and 2 on waist belt; accessary snap and ring; friction buckle; waist sizes 30-40". Equal to Cat. # 27012, Forestry Supplier's, Inc.(6 sets)

(4) Rope snap hook, 1 1/8" eye I.D.; 11/16" throat opening; safe load 5000 lbs. Equal to Cat. # 27310, Forestry Supplier's, Inc. (12)

(5) Nylon climbing rope, 1/2" diameter; breaking test weight 6,400 lbs. Equal to Cat. # 83280, Forestry Supplier's, Inc. (800 feet).

(6) Limb chainsaw: 24" chain blade and two 25' cords; weight pouch. Equal to Cat. # 81078, Forestry Suppliers, Inc. (12 units).

(7) Fiberglass tree pruner, 12' telescoping model; pruner blade and saw head; 12' cord. Equal to Cat # 81150, Forestry Suppliers, Inc. (6 units).

(8) Alluminum sectional ladder with 10' sections; side rails 1" X 2 1/2"; interlocking sections. Equal to Cat. # 91069, Forestry Suppliers, Inc. (ten sections).

(9) Cone cutting knife, mounted on wooden block with pivot attachment; 5 1/2" cutting blade; wooden handle. Equal to Sandia Cone Cutter Co. model (only known source of supply). (2 units).

(10) Snap-cut lopping shears, Teflon coated blades, with 30" handles. Equal to Cat. # 79222, Forestry Suppliers, Inc. (6 pair).

(11) Hand pruning shears, 8 1/2 " long; plastic handle covers; adjustable blade. Equal to Cat. # 81130, Forestry Suppliers, Inc. (6 pair).

Extraction/Cleaning

(1) Macerator/Cleaner; stainless steel hopper; flanged, revolving bottom plate; variable speed drive electric motor, 220 V, 50 Hz. Equal to Dybvig Seed Cleaner (Melvin Dybvig, Milwaukie Oregon. (4 units).

(2) Cone tumbler, 3 bu. capacity; chest-type drum enclosure w/hinged top. Hot-rolled painted or galvanized steel.Size: 42" L x 26" W x 42" H (plus motor/drive outside); encloses 7 1/2 cu. ft. variable speed drum w/lockable door for loading. Drum circumference covered w/ 1/2" steel mesh. Seed-cone drawer, 4 cu. ft. capacity. With cycle timer, bell and cycle-end red light. 220 V, 50 Hz 1-ph motor. Equal to Model SLT-3 , McPherson & Assoc.

(3) Cement mixer, 3 cu. ft. capacity; all steel drum and yoke; bronze bearings; 4-blade mixer; adjustable tilt lever; drum 26" diam. and 15" opening; with wheels and electric motor, 220 V, 50 Hz. Equal to Cat. # 7666T13, McMaster-Carr Supply Co. (Catalog 92).

(4) Table-top air-screen cleaner; two screen, one air system cleaner; 34" long, 18" wide, 27" high; 1/4 hp split phase 230 V, 50 Hz motor; with 2 screens. Equal to "Office Clipper", Cat. # 400-2, Seedburo Equipment Co. Screen specs: perforated metal, 8 and 9 round holes.

(5) Extra screens (12) for above cleaner. Perforated metal, round holes, sizes: 1/12, 5 1/2, 11, 13, 14, 15, 16, 18, 20, and 22. Perforated metal, oblong holes: 8 X 3/4 and 14 X 3/4.

(6) Air-screen cleaner, scalping capacity up to 75 bu./hr.; ball screen cleaning system; 2-screen, botton air operation; V-belt drive with 220 V, 50 Hz motor; two screens as follows: perforated metal, round holes: 9 and 14. Equal to M2-B Clipper cleaner; Seedburo Equipment Co. Catalog 85, p. 77.

(7) Extra screens for M2-B, all perforated metal. Option A-11 screens: round hole 5 1/2, 8, 11, 13, 15, 16, 18, 20, 22; oblong 14 X 3/4 and 8 X 3/4. Option B-PFI: round holes 5 1/2, 11, 12, 18, and 22; oblong holes 8 3/4 X 14 3/4.

Sind: round holes 8, 13, 15, 18, and 20; oblong hole 14 X 3/4. Punjab: round holes 8, 10, 15, 18, and 20; oblong hole 14 X 3/4. Total of 19 for option B.

(8) Hand testing screens, 12" X 12"; wooden frames, with the following sizes (25 screens

Round holes: 1/4, 1/12, 5 1/2, 6, 61/2, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 20, 22, 24.

Oblong holes: 6 X 3/4, 8 X 3/4, 10 X 3/4, 12 X 3/4, 14 X 3/4.

Equal to Cat. # 98-12, Seedburo Equipment Co.

(9) Seed aspirator; approximately 40 lbs./hr. capacity; 6 " air column, closed circuit system; 40 lb. O-Max variable speed control; variable speed fan motor, 220 V, 50 Hz, 1-ph. Includes 20" feed hopper and 3'high work platform with 4 access steps at one end,pipe handrail on one side of steps, and aspirator discharge openings (5 7/8" x 31") in platform shelf. Electrical hookups on platform. Equal to Model COS 1 Forest Tree Seed Aspirator, SouthPine, Inc.

(10) Laboratory seed blower; air-column blower w/488 CFM capacity; timer switch; static pressure guage for precision control; damper controls on top of vertical column and on a side arm; 220 V, 50 Hz electric operation. Equal to Stults Scientific Engineering Corp. "Purity Blower."

(11) Floor fan: mobile cooler fan, 36" blade diam., 440 RPM, 13,800 CFM; fan guard front and back; rubber wheels; 230 V, 50 Hz motor; 18' cord. Equal to Cat. # 2074K13, McMaster-Carr Supply Co. (catalog 92).

(12) Hand-held air blower; 1 1/2 HP; 24,500 FPM velocity at nozzle; 220 V, 50 Hz motor. Equal to Tornado Blower Model 98801, Seedburo Equipment Co.

(13) Electric moisture tester; operated by 9-V battery; portable; range of 10 to 25% (corn); automatic sample weight determination. Equal to Insto I moisture tester, Seedburo Equipment Co. Cat 85, p. 8.

Testing

(1) Germinator; electronic control of temperatures from 3° to 50° C.; non-water curtain design; stainless steel exterior; capacity: 22 trays at 2" spacing, tray size at least 19" X 20"; supported on rubber-wheeled casters; 2 flourescient tubes on each side for light; 1/4 HP compressor; external indicator of internal temperature; overall size not to exceed 32" W and 36" D; refrigeration compressor top-mounted; 220 V, 50 Hz operation; 22 trays per germinator. Equal to Stults Scientific Engineering Corp. Model D-4 Dry Germinator.

(2) Transparent acrylic rectangular germination boxes; friction fitting lids:

4 5/16" X 4 5/16" X 1 3/8" size (200 units)
7 3/8" X 5 5/16" X 3 5/16" (96 units)

Equal to Cat. # T156C and T69C, Hoffman Manuf. Co.

(3) Transparent acrylic round germination containers; friction fitting lids, 4 1/4" diameter, 7/8" height (160 units). Equal to Cat. # T56C, Hoffman Manuf. Co.

(4) Germination paper; non-toxic circular blue blotter, 4 1/8" diameter (2M); circular white filter paper, 3 1/2" diameter (1M); white blotter, 4 1/8" X 4 1/8", absorbs 6 times weight in water. Equal to Cat. # 3450-0004, Stults Scientific Engineering Corp.(10M); White blotter, 6" X 9" same as above. Equal to Cat. # 3450-0609, Stults Scientific Engineering Corp.(10M).

(5) Stereo microscope; dual illuminating system; 1 X objective and 10 XWF ocular; includes transformer for 220V, 50 Hz operation. Equal to Cat. # 4E1220 and K-22 Transformer, Seedburo Equipment Co.

(6) Refrigerator, household type, 12 cu. ft. total capacity (8 cu. ft. refrigerator, 4 cu. ft. freezer); adjustable temperature control; steel exterior with enamel finish; magnetic door closure; operate on 220 V, 50 Hz.

(7) Sample scarifier, small lot; 5 3/4" diam. drum ; 1/3 HP 220 V, 50 Hz electric motor; 1725 RPM. Equal to Forsberg Sample Lot Electric Huller/Scarifier.

(8) Laboratory oven, 1.5 cu. ft.; forced air; 50° to 200° ± 3° C. range; temperature display; 2 crome-plated steel shelves; 220 V, 50 Hz. Equal to Isotemp Model 616 F. Fisher 88 Cat. # 13-245-616 F.

(9) Top-loading electronic balance; 400 g capacity; 0.01 g sensitivity; 100 g capacity: 0.001 g sensitivety; 220 V, 50 Hz operation. Equal to Fisher Dual-Range XT-400 D Fisher 88 Cat. # 01-913-279.

(10) Purity workboard, lighted; 13" X 14" work top; 220 V, 50 Hz. Equal to model in Hoffman Manuf. Co. Catalog, p. 28.

(11) Sample divider, Boerner type; brass and copper construction; 31" high; w/2 pans. Equal to Model 34, Hoffman Manuf. Co.

(12) Electronic sample counter; batch and total counts; handles seed sizes 0.8 to 12.7 mm in diameter; solid state electronics; 220 V, 50 Hz operation. Equal to Audiotronics Model A-3310, Hoffman Manuf. Co.

(13) Seed triers; double tube brass, nickel plated; 1/2" outside diameter; 18" and 30" lengths (2 of each size). Equal to Seedburo Equipment Co. Cat. # 180 and 236.

(14) Plastic desiccating cabinet; dimensions: 12 1/2" X 15 1/4" X 20", with 3 trays. Equal to Fisher 88 Cat. # 08-647-24.

(15) Desiccant, 8-mesh, indicating (10 lb.). Equal to Fisher 88 Cat. # 07-578-3B.

(16) Sample cans, aluminum; 3 1/2" diam. X 2" high; with covers (3 doz.) Equal to Fisher 88 Cat. # 03-485C.

(17) Scoops, cast aluminum; 24 and 48 oz. capacities. Equal to Cat. # 5281 and 5283, Hoffman Manuf. Co.

(18) Foreps, tapered shanks, medium sharp points; 4 5/8" long. Equal to Cat. # 57.401, Hoffman Manuf. Co.

Storage

(1) Cardboard fiber drums, 12 gal. capacity; 225 # construction; locking top band, rubber gasket cover. Equal to CFI Weatherpack-Leverpack Fibre Drum. (100 units).

(2) Storage bottles; wide-mouth, high density polyethylene, with twist-top cap; built-in handle; 1 gal. capacity.

(3) Plastic pails, 5 gal. capacity; bail-type handle; double-rib design to permit stacking; seamless, high-density polyethylene; plastic resealable lids, tubular gasket. Equal to Cat. # N-06274-25 and N-06274-35, Cole-Parmer Co.

(4) Polyethylene bags, transparent, 4-mil wall thickness. 18" X 26" (1M); 34" X 34" (1M); 24" X 30" (1M).

Walk-in Cooler

Prefabricated walk-in cooler for indoor installation, O.D. 26'11"x13'6"x12'0" high with prefab floor. Must maintain 2° ± 2° C with ambient temperature as high as 43° C.

Insulated panels: "Poured-in Place" polyurethane foam, 4" thick. Including 2" wide steel strap imbedded in urethane interconnecting patented "Speed-Lok" mechanism. All panels have tongue and groove construction including vinyl gaskets at every panel joint. Interior and exterior 0.026" bright galvanized steel. Thermal conductivity of 0.00295 BTU/Hr. Sq. Ft.

Door: flush mounted 42"x78" hinged, door panel shall include a heavy "U" channel type, reinforced steel frame. Door is complete with magnetic gaskets, inside safety release, 2" dial thermometer 3-heater wires, condensate heater control, self-closing hinges and vapor proof light fixtures with toggle switch and pilot light.

Refrigeration: Remote system, pre-assembled, air-cooled. Compressor to be installed outside at ground level; will require 25' of refrigeratant piping and insulation.

Lighting: Includes two ceiling lights, 100 W bulbs, installed in center of cooler approximately 8' from each end; outside switch.

More details are included in the enclosed commercial proposal.

Commercial Sources of Equipment Listed

Cole-Parmer Instrument Co.
7425 North Oak Park Ave.
Chicago, IL 60648-9930
1-800-323-4340

Continental Forest Industries (CFI)
Fibre Drum Division
1902 Leland Drive, Suite 3
Marietta, GA 30067
(404) 952-7374

Melvin R. Dybvig
1425 SE Riovista
Milwaukie, OR 97222
(503) 659-0718

Fisher Scientific
50 Fadem Road
Springfield, NJ 07081
(201) 467-6400

Forestry Suppliers, Inc.
205 West Rankin Street
P.O. Box 8397
Jackson, MS 39204
1-800-647-5367

Fred Forsberg & Sons
P.O. Box 510
Thief River Falls, MN 56701
(218) 681-1927

Hoffman Manufacturing Co.
30392 Walnut Drive, S.W.
Albany, OR 97321
(503) 926-2920

McMaster-Carr Supply Co.
P.O. Box 4355
Chicgo, IL 60680-4355
(312) 833-0300

Sandia Cone Cutter Co.
2595 Cohansey Street
Roseville, MN 55113
(612) 483-1061

Seedburo Equipment Co.
1022 West Jackson Blvd.
Chicago, IL 60607
(312) 738-3700

Southpine, Inc.
P.O. Box 7404
Birmingham, AL 35253
(205) 879-1099

Stults Scientific
Engineering Corporation
3313 South 6th Steet Hwy
Frontage Road West
Springfield, IL 62703
(217) 529-3723

R. W. McPherson & Assoc.
P. O. Box 5011
Monroe, LA 71203
(318) 343-5957

BMIL International
* Trademark/Bally Case & Cooler Inc. Bally, Pa
A Division of Balfour, Maclaine International Ltd.
Wall Street Plaza (88 Pine Street), New York, New York 10005 • Phone: (212) 425-2100 • Cable: FLEETINTL • Telex: RCA 23-2072

October 13, 1988

PROPOSAL NO: 18-7803-JG

YOUR REF NO: Seed Storage Pakistan

U.S. Forest Service
P.O. box 906
Starkville, Miss 39759

Attn: Mr. Frank Bonner

Bally prefab for indoor use. O.D. 26'11"x13'6"x12'0" high with prefab floor.

BALLY PANEL FINISH

.026" bright galvanized steel, interior and exterior.

BALLY PANEL SPECIFICATION

" (10cm)

Panels are "Poured-in-Place" polyurethane foam. Including 2" (5cm) wide steel strap imbedded in urethane interconnecting patented "Speed-Lok" mechanisms. All panels have tongue and groove construction including vinyl gaskets at every panel joint.

HERMAL CONDUCTIVITY:

4" (10cm) .0295 BTU/HR Square Foot (1.017 watts/meter °K)
K Factory: .118 BTU INCH/HR Square Foot (0.017 watts/meter °K)

Panels are U.L. certified and have flamespread rating of 25 or lower and smoke generation of 450 or lower when tested in accordance with ASTM E-84-76. All panels approved by factory mutual as class I building type.

DOORS

All doors are our standard flush mounted 42"x78" hinged, door panel shall include a heavy "U" channel type, reinforced steel frame. Door is complete with magnetic gaskets, inside safety release, 2" dial thermometer, 3-heater wires, condensate heater control, self-closing hinges and vapor proof light fixtures with toggle switch and pilot light.

QTY	SIZE	TYPE
One (1)	42"x78"	R.H. Hinged

REFRIGERATION

Bally Thermobalanced, Pre-Assembled, Air-Cooled-Electrical 380-400/3/50

Refrigeration comes complete with:

- Weather proof hood
- Expansion Valve
- Filter-Drier
- Heat Exchanger
- Distributor
- Fan Motors with Blades and Brackets
- Solenoid Valves
- Defrost Heaters (where applicable)
- Thermostatic Expansion Valve
- Defrost Klixon (where applicable)
- Fan Delay Klixon
- Temperature Control
- Time Clock
- Contactors (as required)
- Sight Glass
- Interlock Relay
- Pan Defrost Heaters (where applicable)

QTY	MODEL	H.P.
One (1)	PN300A-2	3

TOTAL BUGETARY NET FAS NEW YORK $16,700.00

We are not including in the above:

Lighting*
Refrigerant*
Refrigerant Piping*
Refrigerant Pipe insulation*
Electrical Wiring
Spare Parts*
Strip Curtains*
Vestibule Doors*

(*) These items can be supplied upon request.

Total estd. weight: 10,100 lbs.
Total estd. volume: 900 cu. ft.

Container requirements: One (1) 20 ft. container

Delivery: 8-10 weeks
Valdiity: 60 days

Payment: By confirmed irrevocable letter of credit payable at sight in N.Y. in USD with all bank charges for opener's account.

Other available options accessories:

5" or 6" panels
Sheet metal wall protectors/rub rails
Observation windows
Temperature alarms
Shelving

NOTE:

Erection supervision is available at a cost of $400.00 per day door to door not including roundtrip airfare, meals and lodging, which would be extra at actual cost.

Joseph Gervase
Regional Sales Manager
BMIL INTERNATIONAL

B A L L Y R E F R I G E R A T I O N L O A D C A L C U L A T I O N

DB: US FOREST SERVICE
DOM NAME: PAKISTAN SEED — 10-13-1988
ENGTH: 26'11 WDTH: 13'6 HT: 12'0 FILE NO.1234 WITH FLOOR
ONDENSING UNIT LOCATED OUTDOOR
UILDING LOCATED INDOOR
MBIENT TEMP 110 F BOX TEMP 35 F STORAGE ONLY ENTER TEMP: 35

S U R F A C E H E A T G A I N S

'' URETHANE	OUTER WALLS	970 SQ/FT X 0.0320 X 24 X 75 TD =	55,872
'' URETHANE	CEIL. AREA	363 SQ/FT X 0.0320 X 24 X 75 TD =	20,909
'' URETHANE	FLOOR AREA	363 SQ/FT X 0.0320 X 24 X 25 TD =	6,970

A I R C H A N G E L O A D

OLUME	3,817 CU.FT X 8.438 X 3.18 X 1 FOR AVE. USAGE A/CHG	=	102,421

M I S C H E A T G A I N S

OPLE	1 X 895 BTU/PERSON/HR X 8 HRS	=	7,160
GHTS	400 X 3.42 BTU/HR/WATT X 8 HRS	=	10,944
TORS	1 H.P. X 2950 X 8 hrs.	=	23,600
APORATOR FAN MOTOR LOAD		=	31,970

E-ASSEMBLED REMOTE R COOLED	BTU/24 HRS	=	259,845
	+10% SAFETY	=	25,985
	TOTAL BTU'S/24 HRS	=	285,830
	BTU'S/HR/16.0 HCO	=	17,864

Q U I P M E N T S E L E C T I O N

CONDENSING UNIT		EVAPORATOR COIL
1 RQD)3 HP PN300-2	THERMOBALANCE 380/400/3/50	WITH (1 RQD) EVAP.COIL BA300A-2 200/220/1/50

TEMP 24 F — SYSTEM CAPACITY = 21,970

ADJUSTED FOR 50 CYCLE ** ((TOTAL SYSTEM(S) CAPACITY)) = 21,970
S OF COMPRESSOR OPERATION = 13.1 AT 110 F AIR TO CONDENSER

****

ease review these calculations. If we have assumed any incorrect temperatures-
ads-etc.-- please notify us immediately as it will affect the size of the
frigeration equipment. The recommendations are based on normal operating condi
ons. We will not be responsible if these figures are inaccurate due to factors
the field over which we have no control. (010187)
ally Engineered Structures/Bally, Pa. 19503)

B A L L Y R E F R I G E R A T I O N S P E C I F I C A T I O N

OB: US FOREST SERVICE 10-13-1988
OOM NAME: PAKISTAN SEED FILE NO.1234
ENGTH: 26'11 WDTH: 13'6 HT: 12'0 WITH FLOOR
ONDENSING UNIT LOCATED OUTDOOR
UILDING LOCATED INDOOR
MBIENT TEMP 110 F BOX TEMP 35 F STORAGE ONLY ENTER TEMP: 35

EOPLE 1 LIGHTS 400 WATTS
OTORS 1 H.P.

- -

* ADJUSTED FOR 50 CYCLE **
RE-ASSEMBLED REMOTE TOTAL BTU'S/HR = 17,864
IR COOLED TOTAL SYSTEM(S) CAPACITY = 21,970
VAP. TEMP 24
RS OR COMPRESSOR OPERATION = 13.1 AT 110 F AIR TO CONDENSER

****

he recommendations are based on normal operating conditions. We will not be re-
ponsible if these figures are inaccurate due to factors in the field over which
e have no control or incorrect information supplied by the customer. (010187)

****

-7 1/2HP Thermobalance - Remote; Pre-assembled; Self-contained.
Standard Features include:
...Condensing Unit: Receiver; Dual Pressure Control; Contactor/Start
...Relay; Vibration Eliminators; Manual Pump Down Switch; Weatherhood.
....Disconnect Switch(except Self-contained);
...Oil Pressure Control(5-7-1/2 HP)
...Winter Control & Crankcase Heater (Self-contained).
- Evaporator Coil: TX Valve; Distributor; Drier; Solenoid Valve;
....Temperature Control; Sight Glass; Time Clock; Heat Exchanger; (Low
...Temp and Medium Temp with Electric Defrost include - Defrost
...Contactor; Defrost Heaters; Interlock Relay; Defrost Klixon; Fan
....Delay Klixon.

****

TY.	PART NO.	DESCRIPTION	*TOT.AMPS	CD	ELECTRICAL
1	003081	PN300-2	6.9	D	380/400/3/50
1	000123	BA300A-2	2.2	E	200/220/1/50

[redacted]

* CONDENSER AMPS ARE RLA, EVAPORATOR AMPS ARE FLA
ARRANTIES:
COMPLETE- $ 0 NET COMPRESSOR- $ 0 NET LABOR- $ 0 NET
OMPLETE SYSTEM WARRANTY INCLUDES ALL COMPONENT PARTS FOR BALLY FURNISHED
* CONDENSING UNIT AND EVAPORATOR FOR A 5 YEAR PERIOD.
OMPRESSOR WARRANTY INCLUDES COMPRESSOR ONLY FOR A 5 YEAR PERIOD.
ABOR WARRANTY INCLUDES LABOR ONLY FOR A 1 YEAR PERIOD.
* FOR ADDITIONAL WARRANTY INFORMATION, CONTACT BALLY OR YOUR SALES REP.
WIRING DIAGRAM NO. BUILT TO UL STANDARDS
CUSTOMER APPROVAL _____ DATE _____

FOR BALLY USE ONLY

COMPRESSOR MODEL _____ REFRIGERATION DEPT. _____

COMPRESSOR SERIAL NO. _____ DATE _____

BALLY SERIAL NO. COND. _____ EVAP: _____ WARRANTY NO. _____

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