The National Seed Storage Laboratory For Genetic Resources in Japan

By HIROSHI ITO* and KINEO KUMAGAI**

Chief, 7th Laboratories*, and Chief, Laboratories of Seed preservation**,
Division of Genetics, Department of Physiology and Genetics,
National Institute of Agricultural Sciences (Hiratsuka)

The National Seed Storage Laboratory for genetic resources was opened in 1966 in the Division of Genetics, Department of Physiology and Genetics, National Institute of Agricultural Sciences, as the centre of Japan for the permanent maintenance and exchange of seed for gentic resources. This Laboratory is one of the main facilities of the Genetic Resources Project for Crops, Ministry of Agriculture and Forestry, started in the same years. So the Laboratory belongs to the Institute but it is operated under the supervision of the Agriculture, Forestry and Fishery Research Council, Ministry of Agriculture and Forestry.

The numbers of seed materials accepted for storage are steadily increasing, making a total of 9,634 samples in 44 species until the end of April 1969, with 7,513 samples in 8 species of food crops, 795 samples in 29 species of horticultural crops, 1,244 samples in 4 species of industrial crops and 82 samples in 3 species of fodder crops.

Roles of the laboratory

The permanent maintenance of genetic resources has hitherto been undertaken by each breeder or geneticist. But nowadays the demands for genetic resources are very wide and strict due to rapid development of breeding and genetics, so it has become necessary to have a specialized organization for this purpose.

The main roles of the Laboratory are, primarily to maintain the genetic constitutions of materials for genetic resources to give possibilities of the reappearance of the results of breeding and genetical studies; secondly to collect and to maintain huge numbers of materials for genetic resources with necessary information and exchange ability which can not be expected by each breeder or geneticist, and thirdly, to prevent the loss of valuable genetic resources which are disregarded at present.

Principle of long-term storage

Before the development of long-term seed storage methods, it was very difficult to complete the above mentioned roles at genetic resources centre, as it is impossible to raise seed free from the effect of natural selection acting in successive seed raising in field. The authors have started a study to develop ways to store seed for long-term since 1956 and the principles were reported by Ito and Hayashi (1960a,[2] 1960b,[3] 1961[4]) and a new breeding system based on long-term seed storage was presented as Ito (1965).[5] Owing to the development of air-conditioning and freezing industry, long-term seed storage has become very easy and popular, and it now is the basic method of the maintenance of plant materials for genetic resources.

Harrington, J. F. (1967)[1] reported to the FAO/IBP Joint Conference for plant genetic resources, held in Rome, Italy in 1967 that "it appears possible to keep seed of most spe-

cies for hundreds of years if the storage conditions are ideal." He also wrote: "Ideal storage conditions for seed of most species include a relative humidity of about 15%, a temperature as cold as possible (preferably at a deep freeze temperature of −20°C or lower), atmosphere low in oxygen and high in carbon dioxide, an absence of light, and a storage room for container that minimizes radiation damage."

Under the ideal condition cited above, moisture contents of seed are about 4 to 6%. Roberts, E. H. (1960,[7] and 1961[8]) studied relationships between longevity of seed and storage conditions and concluded that storage temperature and moisture content of seed are the most important factors affecting the longevity of seed. He also gave an empirical formula as under:—

$$\log p = Kv - C_1 m - C_2 t$$

where p=half viability period (weeks), m= moisture content of seed (%), t=storage temperature (°C), Kv, C_1 and C_2 are constants. (In case of rice, Kv=5.686, C_1=0.159 and C_2= 0.069.) Above empirical formula shows the duration at which the germinability of seed will be 50%. But 50% of germinability is too low for practical purposes and there is a logarithmic relation between germinability percentage and the duration. So the authors have calculated the period of 90% of germinability for rice according to the above empirical formula and obtained Table 1. The estimated period in Table 1 corresponds well to the experimental results of rice seed under various conditions studied by Ito and Hayashi (1965[5] and unpublished[6]) since 1956.

Works in the laboratory

The works in the seed storage house are systematically given in Fig. 1. The essential parts of the works in the seed storage house are maintenance and exchange of seed samples and information. In Fig. 1, information services are undertaken only in the office room and other rooms are for seed storage including re-processing, cleaning, weighing and germination test.

To provide all the functions mentioned in Fig. 1, the ground plan of the National Seed Storage Laboratory is designed as Fig. 2. In this Laboratory, the rooms are used not only for storage but also for research works on seed storage. The location of the Laboratory is selected along the main road of the Institute and only the office room and workshop No. 2 are faced sunshine as Fig. 3. Distinctive points of the design of the Laboratory are given according to the order of rooms.

Room No. 1. Entrance: To be free from dust, all visitors are requested to change their shoes to the special ones only for the Labora-

Table 1. The period of 90% of germinability for rice seed.

Moisture content of seed	Storage temperature (℃)									
	−10	−5	0	5	10	15	20	25	30	35
%	years	years	years	years	years	years	years	years	years	years
4	1,606	726	328	148	67	30	14	6	3	1
6	772	349	158	71	32	15	7	3	1	1
8	371	168	76	34	15	7	3	1	1	—
10	179	81	36	16	7	3	2	1	—	—
12	86	39	18	8	4	2	1	—	—	—
14	41	19	8	4	2	1	—	—	—	—
16	20	9	4	2	1	—	—	—	—	—
18	10	4	2	1	—	—	—	—	—	—
20	5	2	1	—	—	—	—	—	—	—

* counted as one fractions of more than 0.5 inclusive.

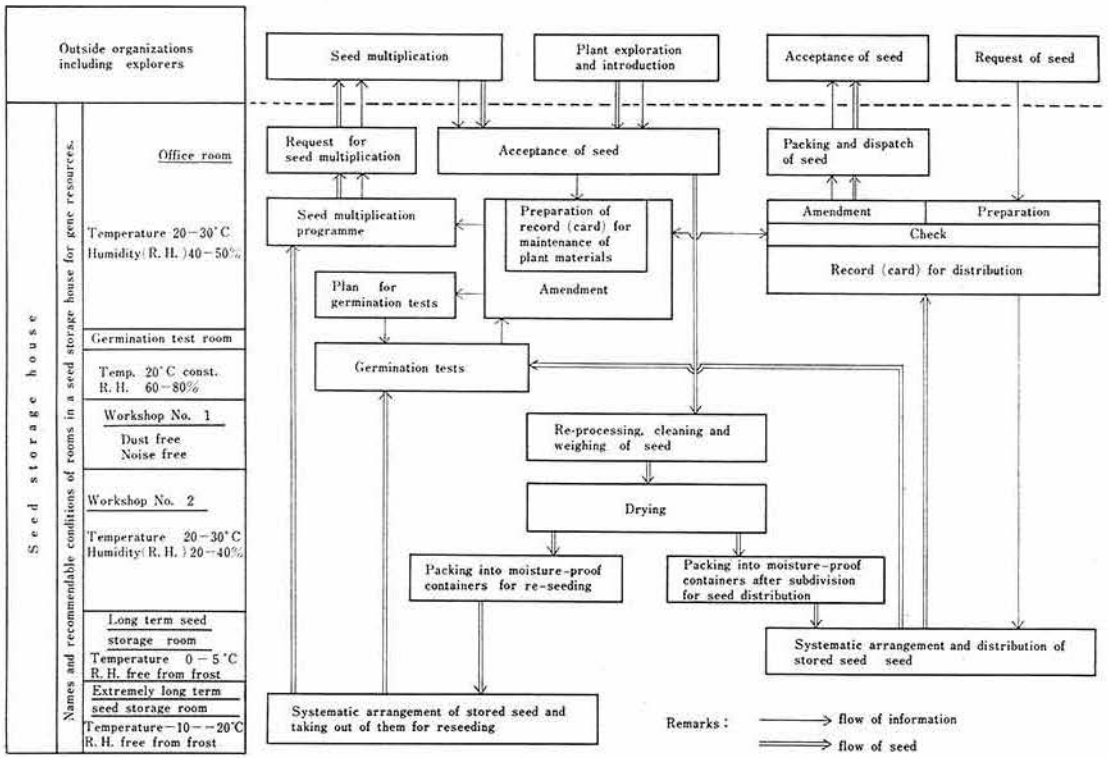
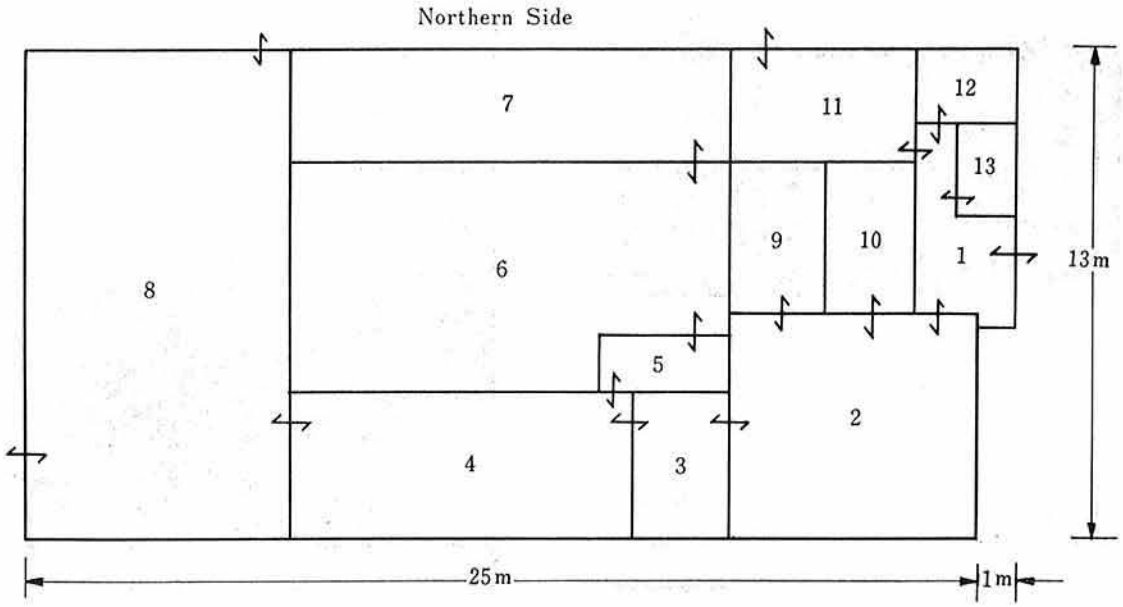


Fig. 1. A flow chart of works in seed storage house.



Room No.	Name of room	Area (sq. m.)	Conditions		Remarks
			Temp. (℃)	R.H. (%)	
1.	Entrance	9.38	—	—	
2.	Office	39.00	20-30	low	
3.	Workshop No. 1 (Re-processing etc.)	10.00	—	—	Dust free
4.	Workshop No. 2 (Drying and packing)	39.36	20-30	30	
5.	Preliminary room	6.00	—	—	
6.	Long-term seed storage room	63.00	− 1	30	
7.	Extremely long-term seed storage room	34.50	−10	30	
8.	Machinery room for rooms Nos. 4-7	91.00	—	—	
9.	Germination test room No. 1	10.00	constant	—	15-35℃
10.	Germination test room No. 2	10.00	variable	—	15-35℃
11.	Machinery room for rooms Nos. 9-10.	15.00	—	—	
12.	Lumber room	5.00	—	—	
13.	Lavatory	3.75	—	—	
	Total	335.99			

* Cost for building and air-conditioning machineries as US$ 114,125 in 1965.

Fig. 2. Ground plan of the National Seed Storage Laboratory for genetic resources, Hiratsuka, Kanagawa, Japan.

tory at the entrance.

Room No. 2. Office room: The main works in the office room are information and seed exchange services. Fig. 4 shows the main part of the office room when the registration of newly accepted seed is undertaking. Hand-sorted punch card is used for registration. The control board of backside makes possible to know all the air-conditioning status and to regulate air-conditioning machines from this board.

Room No. 3. Workshop No. 1: Origins of

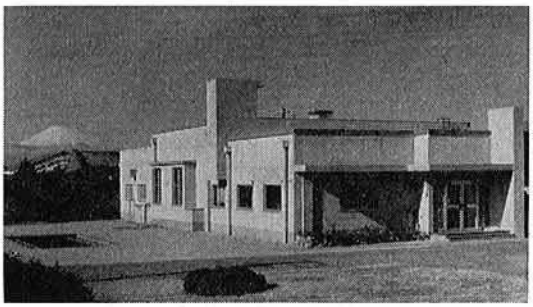


Fig. 3. General view of the National Seed Storage Laboratory of Japan from south-eastern direction together with Mt. Fuji.

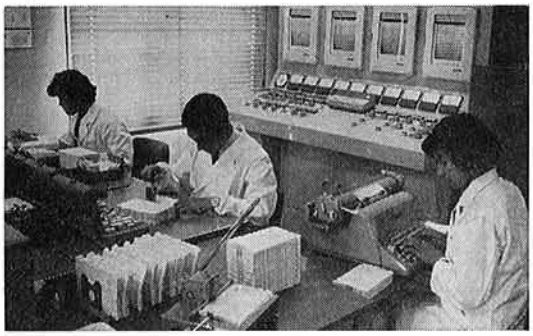


Fig. 4. Interior of the office room in the Seed Storage Laboratory. Recording of information of newly stored seed on hand-sorted punch card in front of the control board of machineries for air-conditioning.

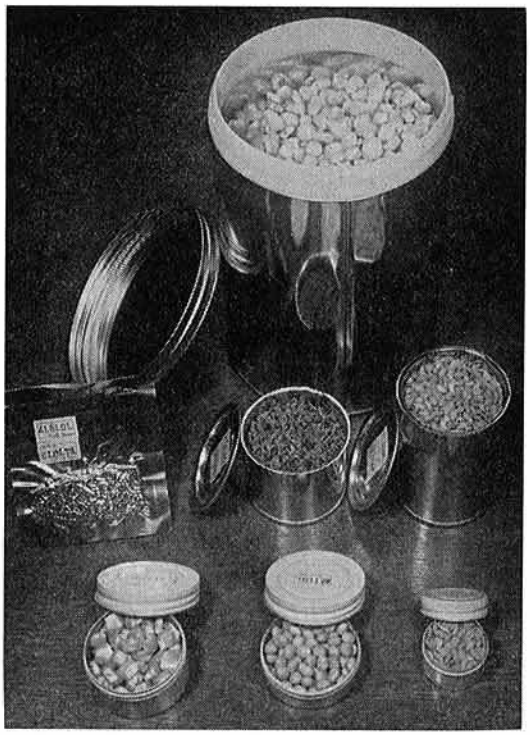


Fig. 5. Various types of moisture-proof seed containers for genetic resources. Three tins in the back are for extremely long-term seed storage under −10°C for seed renewal, and three small tins in the front row and metal bag in the middle row are for long-term seed storage for seed distribution.

accepted seed are scattered from all over Japan and abroad in some cases. To make grading of seed, recleaning of accepted seed is done sometimes. This room is covered with sound-proof walls and ceiling and a strong ventilation fan is equipped to be free from dust.

Room No. 4. Workshop No. 2: This is the most distinctive room in the Laboratory. Japan is one of the most humid countries in the world, so it is very difficult to dry seed down to 4~6% of moisture contents which are suitable for long-term storage, as the drying temperature of seed should not exceed 40°C. This room being intensely dehumified to less than 30% of relative humidity makes possible to dry seed well and also the seed will not absorb the moisture during the subsequent packing.

To cope with the difficulty to keep such dried condition for a long period under low temperature, dried seeds are packed into moisture-proof containers. Suitable containers for distribution and extremely long-term storage for seed renewal are selected and in use as shown in Fig. 5~7.

Room No. 5. Preliminary room: This is an ordinary room which is attached to the cold storage room so no special explanation is necessary.

Room No. 6. Long-term seed storage room: This room is distinctive in having well ar-

Fig. 6. Packing of seed into moisture-proof containers for distribution. In an air-conditioned room of 20–30°C with 30% of relative humidity.

Fig. 7. Packing of seed into moisture-proof containers for extremely long-term seed storage (for seed renewal) in an air-conditioned room of 20–30°C with 30% of relative humidity.

ranged book cases for each variety into which small moisture-proof containers of the seed for distribution are piled up, as is seen in Fig. 8. Quantity of seed for distribution is 300 grains as the standard, thus the seed containers are different by the size of grains, and so the book cases are also different by the size of containers. In Fig. 8, the right side is for rice and the innermost places are for brassica, sesame and other small grains.

Room No. 7. Extremely long-term seed storage room: This room is not so much different from Room No. 6 except the very low temperature. To facilitate the activities of the workers in the room, the walls have very warm color (pink) compared with the color in Room No. 6 that is orange yellow.

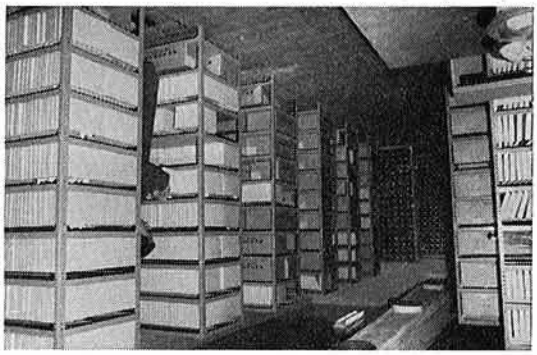


Fig. 8. Arrangement of stored seed for distribution in the long-term seed storage room of −1°C with 30% of relative humidity.

Room No. 8. Machinery room for rooms Nos. 4~7: This room is opened in north, west and south directions with wide windows to cool the machineries. To this room an oil tank of 2,000 litres and a cooling tower are attached.

Rooms No. 9. and No. 10. Germination tests rooms: These rooms are air-conditioned ranging 15~35°C. Among the range, it is possible to adjust the temperature constant in Room No. 9 and change in the daytime and night in Room No. 10. At least 2,000 lux of light is given by grow lamps from the walls in any places of these rooms. Preparation of seed for germination test and counting of germination are undertaken in the rooms. In some cases, the office room is used for the above purpose.

Room No. 11. Machinery room for rooms Nos. 9~10: In this room a package type air-conditioner is installed for each of Rooms No. 9 and 10.

Room No. 12. Lumber room and Room No. 13. Lavatory: Lumber room is used for the cleaning of petri dishes after germination test by an automatic washer.

Service

From this Laboratory, the Index Seminum is issued at every year end. If anyone wants to get the seed for genetic resources and/or

Index Seminum, write to the following address:—

Research Coordination Section
Agriculture, Forestry and Fishery Research Council
Ministry of Agriculture and Forestry
Kasumigaseki, Chiyoda-ku, Tokyo,
100 JAPAN.

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