PN-ABE-140

Sector Agrario

INIAA

Instituto Nacional de Investigación
Agraria y Agroindustrial

INTERNATIONAL POTATO CENTER (CIP)

64428

Low Cost Thermotherapeutic Chamber for the Eradication of Potato Viruses

1989

AGRARIAN SECTOR
NATIONAL INSTITUTE OF AGRARIAN AND
AGROINDUSTRIAL INVESTIGATION

NATIONAL POTATO PROGRAM

Low Cost Thermotherapeutic Chamber for the Eradication of Potato Viruses

Juan Aguilar*
César Vittorelli**
Oscar Santisteban K.***

---

* Potato-Seed Production Specialist
** Head of the Potato-Seed Production Project
*** Professor, Head of the Potato Program of the National University of Cajamarca

Translated from: Aguilar, J.; Vittorelli, César; Santisteban, O. 1988. Cámara de Termoterapia de bajo costo para la erradicación de los virus de la papa. Lima, Instituto Nacional de Investigación Agraria y Agroindustrial. 30 p. (Boletín Técnico No. 1).

This publication was processed and printed
by the Communications Unit,
International Potato Center, Lima, Peru, 1989.

Copies printed: 500

ISBN-92-9060-133-7

CONTENTS

Page

Introduction 5
Construction 7
Materials and equipment 15
Bibliography 17

INTRODUCTION

In potato production, tuber seed often carries viral infections, which spread rapidly in seed production areas by contact between plants, or by means of insect vectors.

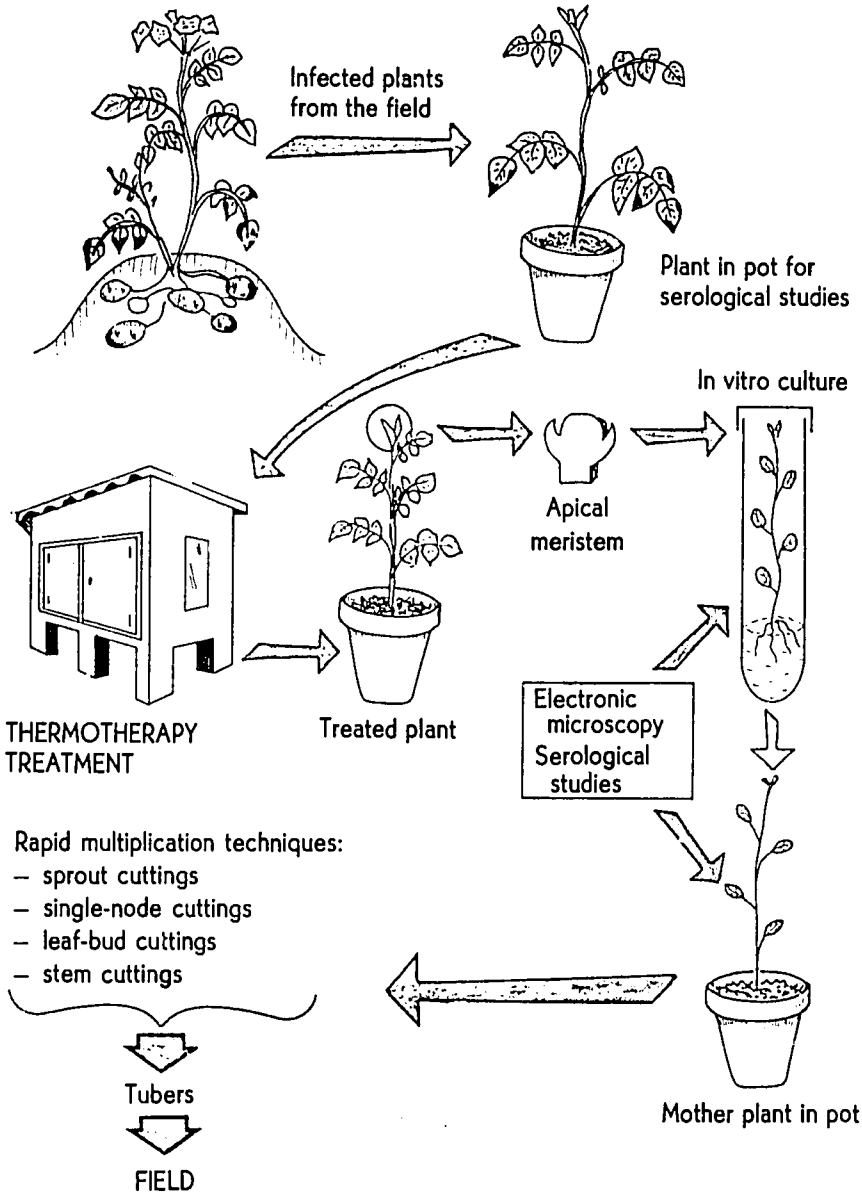
The presence or absence of virus in the potato plant may be detected through the use of various methods such as serology or inoculation in a range of indicator plants.

Elimination of these pathogens to produce the basic seed, is generally carried out by organizations specializing in the eradication of the same, using a diversity of methods. One of the principal and most effective methods is the use of thermotherapy, Lê and Collet (1985), Pennazio and Vecchiati (1978), Smith and Mellor (1970), Schilde and Espinoza (1981), which not only deals with the eradication of viral infections, but also allows for meristem development studies, serological tests and rapid multiplication techniques for seed production (Diagram 1).

The National Potato Program of Peru, with contributions from CIP-INIAA-COTESU CONTRACT, has developed a simple, practical, and low cost thermotherapeutic chamber in La Molina Experimental Station, in Lima. This chamber has demonstrated its efficiency in the eradication of virus in the principal improved and native potato varieties studied by the National Programme in the production of the potato seed.

This booklet shows how to build this chamber so that it can be used in any seed production program.

Diagram 1. Outline of the cleaning process



Foundations

The foundations, or feet, consist of six cubes of 0.45 m each side, within a rectangular surface of 2.02 m x 1.33 m, one being placed in each of the four corners and two at the centre of the two longest sides (Plan: ground plan).

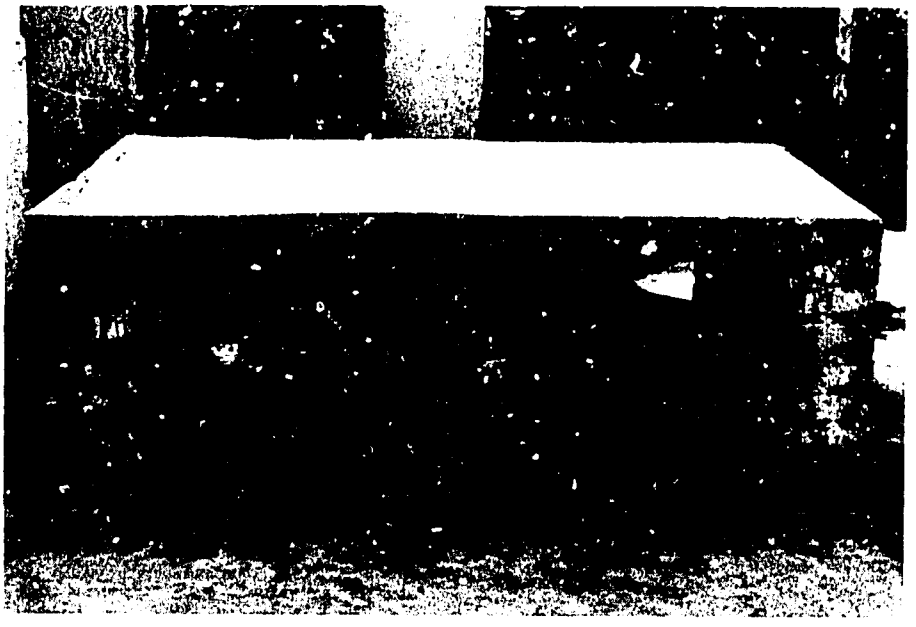
For the foundations use a good mixture of concrete, sand, cement and heavy stone (Fig. 2, Plan B).

Pillars

Onto these foundations build up bricks using a mixture of sand and cement as joiner, to construct six pillars 0.60 m high (Fig. 1, Front: A. Front wall). This will permit easy loading and unloading of the pots carrying the plants to receive treatment.

Floor: Base of the chamber

The base of the chamber is a concrete floor (cement, concrete, and sand). Empty the mix into a wooden forming constructed at the height of the pillars, thereby making a rectangle 2.02 m long x 1.33 m wide x 0.12 m deep. The floor must have an iron grill constructed of longitudinal rods 1.27 cm (1/2") in diameter and transverse rods 0.63 cm (1/4") in diameter, 0.25 m apart from each other and bound with binding wire. Through the depth of the cement block pass a galvanized iron



tube, 1.27 cm (1/2") in diameter with a washer attached to the bottom end into which an elbow bend is inserted. The function of this will be to drain water from the tank inside the chamber after each processing or treatment (Fig. 2).

Walls

Build walls along the edge of the concrete floor with the bricks placed on their edges. Each wall has specific characteristics depending on the apparatus to be installed into it.

Front wall (Plan: A)

The front wall has a 1.77 m x 1.00 m tongue–in–groove type wooden door. Above the upper frame construct a lintel strengthened with steel supports, 1.27 cm (1/2") in diameter (Fig. 2). Fill the space between the lintel and the roof (0.33 m) with bricks.

On the upper part of the wall, inside a wooden box built slightly into the wall (Fig. 1 and 3), install the on/off switch which controls the ventilator inside the chamber.

Back wall (Plan: B)

On the inside of this wall drill six, 3 cm deep holes, using the 0.79 cm (5/16") drill. Into these place six wooden pegs (one into each hole). Onto these affix six, 5.08 cm (2") ceramic insulators to hold up the three nicron resistors of 1000 w each (Figs. 2, 3). These resistors must be placed parallel and at equal distances from each other in order to obtain the necessary temperature inside the chamber. The temperature will be controlled by a thermostat (Figs. 1,3).

Right lateral wall (Plan: C)

When building this wall, leave a 0.70 cm x 0.35 cm space for a window. Make a wooden window frame 7.5 cm x 7.5 cm wide. Around the edge of this frame make a rim or groove 3 mm deep into which the two window-glasses are placed, being separated from each other by a gap of 7 cm. Secure the glasses using wooden beading with screws. This will facilitate dismantling in the event of their breaking. The use of double glasses creates an air chamber which serves as an insulating device between the internal and external atmospheres, thereby avoiding heat loss or escape.

The window facilitates direct observation not only of the plants during treatment, but also of the relative temperature and humidity readings; check and readjust these controls from the outside using the graded thermostat to avoid the necessity of opening the chamber during treatment (Fig. 1).

Build the thermostat case into the outside surface of the wall at a depth of 8 cm. Make a hole through the wall to the inside, through which place the 30 cm sensor tube of the thermostat (Fig. 1 and 3). To protect the sensor tube, insert a slightly wider plastic tube to "line" the hole. The length of this plastic tube should be the same as the depth of the wall.

The control knob of the thermostat must have a range of 10°C-90°C. It is kept inside the built-in box, on the outside, in order to facilitate adjustment in accordance with the temperature readings made through the window. Connect the thermostat to the electricity network of the resistors, which in turn are joined to the principal electricity switch.

The main electricity switch, situated in a safe box, consists of a 30 A and 250 V power switch, which receives the available electricity current. From this switch, extend the cables connected to the interior light, thermostat, heat resistors and ventilator (Fig. 1 and 3).

Place the thermohygrometer along the internal ledge of the windowsill, with the grading indicator facing outwards to enable the readings to be made from outside and to check the correct working of the thermostat and of all of the systems inside the chamber (Fig. 1 and 3). This instrument consists of a mercury column thermometer with a scale of 30°C-50°C and a precision hygrometer with a scale of 0%-100% R.H.

Left lateral wall (Plan: D)

On the inside surface of this wall, in the centre and at a height of approximately 0.90 m, install the ventilator, whose purpose is to circulate the hot air produced by the resistors inside the chamber and thereby uniform the temperature within the chamber (Fig. 2).

The ventilator is of the model used in refrigeration with a sealed motor to avoid the coiling from being damaged by the humidity. The two principal makers of this type of ventilator are:

- MECA electric motor (Italian) of 10 W, 220/1/60,1450 R.P.M., with a 10" aluminum coil and metallic box support.
- General Electric motor (U.S.A.) of 5 W, 220/1/60, 1550 R.P.M., with a 8 3/4" aluminum coil and metallic box support.

Roof (Plan: A and C)

The roof consists of two sheets of "Eternit" roofing which provide better insulation than does tin roofing. The "Eternit" is supported by a rectangular wooden beam, measuring 5 cm across and 2 m long and placed across the length of the chamber in the centre and on a level with the upper edge of the walls (Fig. 1 and 2).

Besides supporting the roof, it also holds the 0.63 cm (1/4") galvanized metal tube through which the electric cable for the 250 W light bulb passes; this being placed in the centre of the chamber (Fig. 2).

Attach the "Eternit" roofing by means of nails and two laths built into the upper parts of the lateral walls.

The inside of the roof must be airtight. To achieve this, it is necessary to plaster or cement over any openings or cracks which may remain after the attaching of the roof. Cover the "Eternit" with a mud top 2.5 cm deep. This acts to increase the insulation of the chamber and avoid any heat loss or gain due to the changes in the external temperature. Remember, the roof must have a slight incline so that rain water can easily drain off it.

Details

The ventilator switch

The switch is connected to the ventilator through an opening in the upper frame of the door. The switch is of 20 W and 250 V and is protected in a 6" x 8" x 4" wooden box with lid.

Tongue–in–grooved door

Composed of two frames, 5 cm deep x 7.5 cm wide and two tongue–in–groove type wooden doors 2 cm deep. The dimensions of each door are 92.5 cm x 87 cm. They must be rebated double doors to insure that the chamber remains as air–tight as possible. Experience has shown that there is a slight amount of heat lost through the door, but this is small enough to be deemed insignificant (Fig. 1)

Water hold

Coat the concrete floor of the inside of the chamber with a plaster made of cement and sand. Then build a small wall, 8 cm high x 5 cm deep immediately behind the lower front door frame in order to protect it from water.

Next, construct an 8 cm high, 2 cm deep skirting board around the whole of the base of the chamber, making the water hold totally water tight with pure cement.

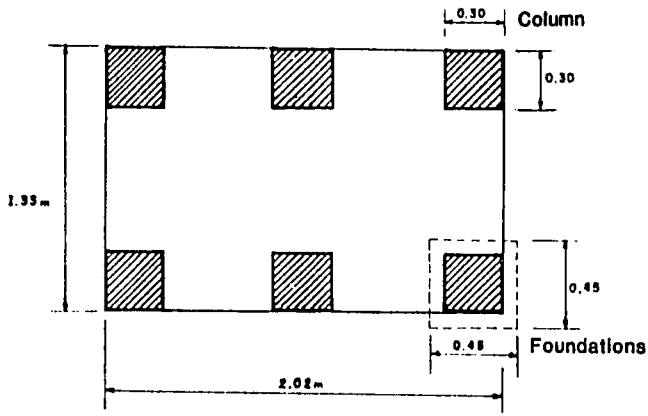
The draining hole must be levelled off so the water can drain out after each course of treatment. The draining hole should be stopped with a rubber or a cork plug. The level of the water is significant in achieving the required relative humidity level uniformly inside the chamber during treatment (Fig. 2 and 3).

Light bulb

Attach a 250 W, 220 V opal light bulb in centre of the ceiling of the chamber, through a 5.08 cm (2") diameter socket, which is attached to a galvanized metal tube nailed into the roof support beam.

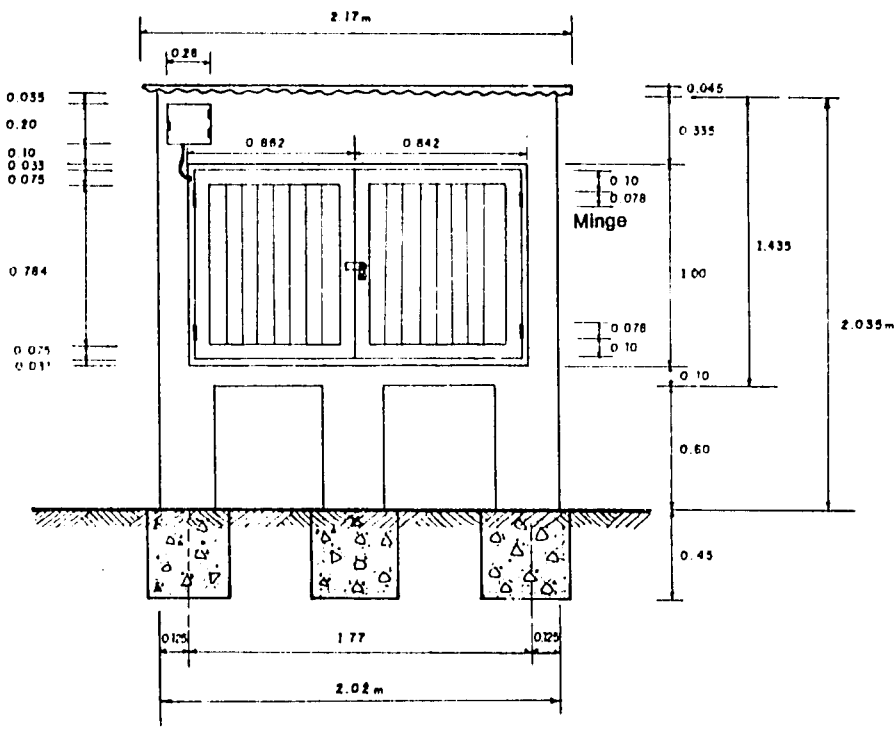
The purpose of the bulb is to supply the light energy (160 W/m^2) to allow the plants undergoing treatment to develop faster (Fig. 2 and 3).

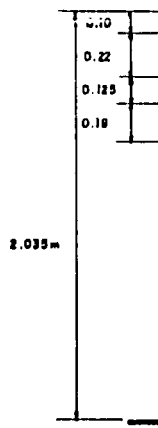
GROUND PLAN



ELEVATION

A.FRONT WALL

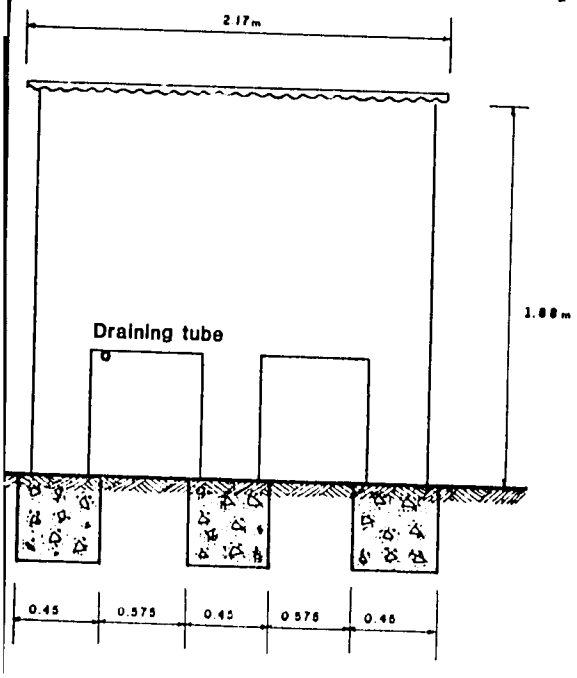




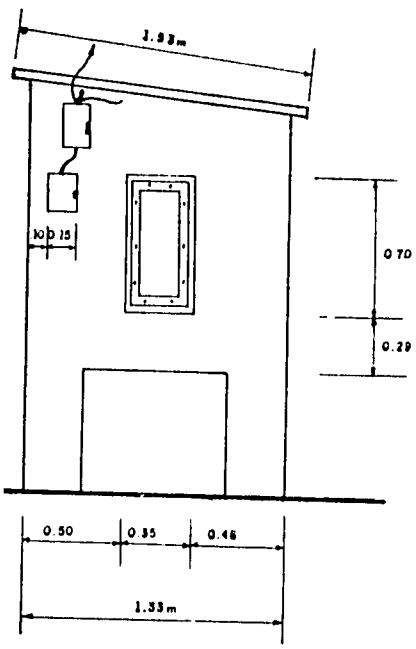
THERMOTHERAPEUTIC CHAMBER

SCALE 1:25

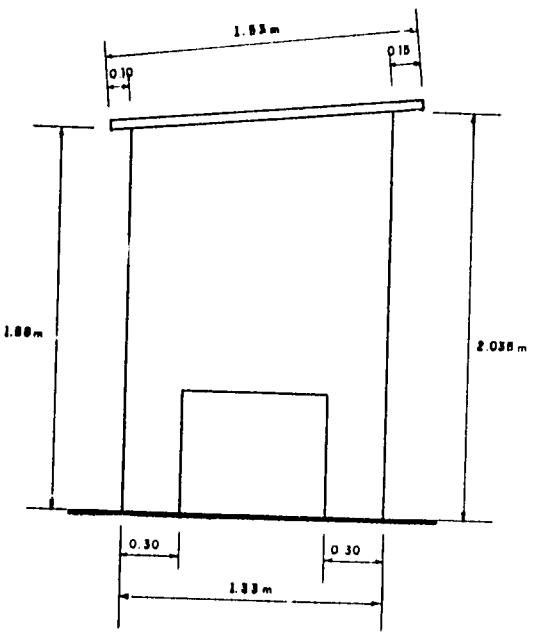
B.BACK WALL



C.RIGHT LATERAL WALL



D.LEFT LATERAL WALL



Plastering

Plaster both the internal and external surfaces of the chamber as well as the brick pillars, i.e. with a coating of a mixture of cement and river sand (Fig. 2). The purpose of this is to improve the maintenance of the whole structure. Finish by painting the chamber with white latex.

Duration of treatment

Sow the plants coming from the infected tubers individually in pots in a suitable greenhouse. When they reach a height of 20 cm, take cuttings and place these into the thermotherapeutic chamber. Place them in pots and stand these on top of inverted pots to avoid contact with the water. The plants are kept in this position for 3-4 weeks at a temperature of 38°C and 85% relative humidity level with continuous light. The chamber can hold up to twelve pots (Fig. 3), which must be placed in such a way as to avoid touching between plants.

Carry out the necessary serological studies before placing the plants into the treatment chamber in order to determine which virus needs to be eradicated.

After treatment, separate the meristems and allow them to develop in vitro. Before they start reproducing, carry out the serological studies once again, looking particularly for those virus which were present before treatment began.

Figure 1. Thermotherapeutic chamber (description)

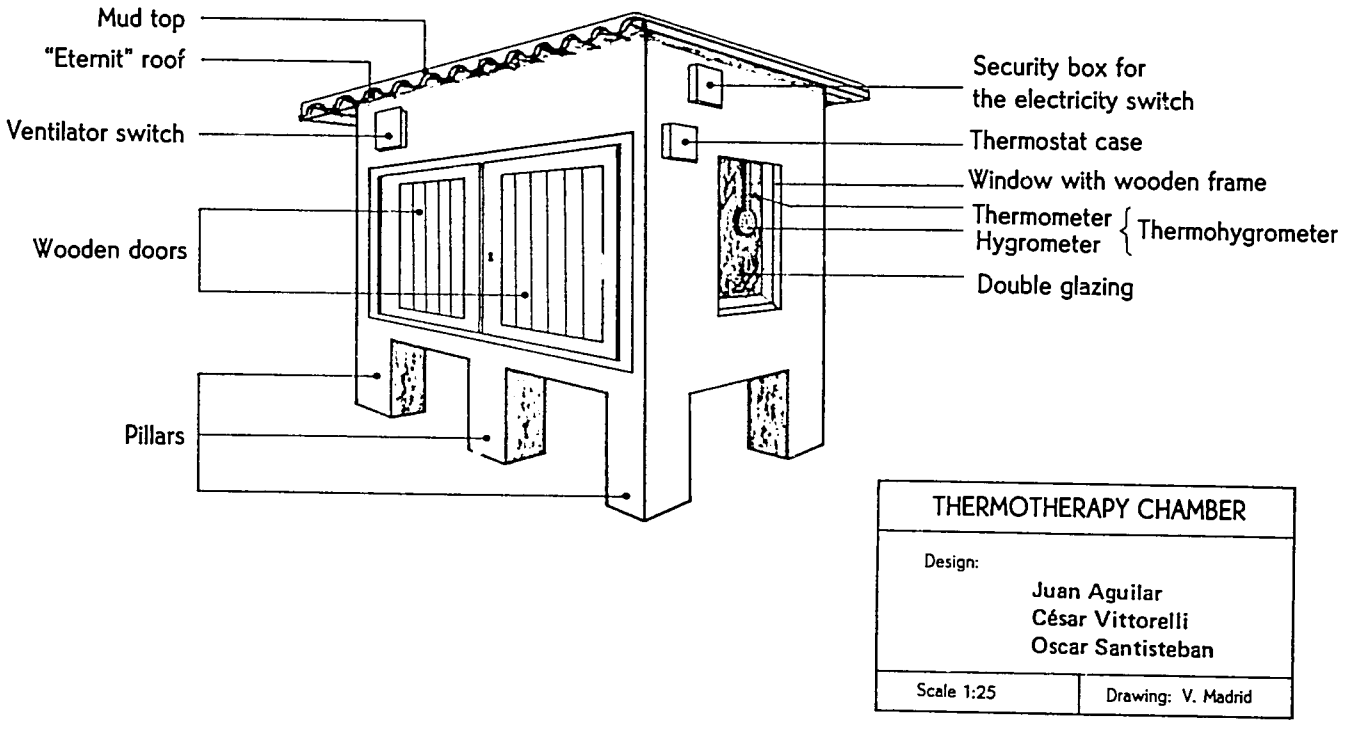


Figure 2. Thermotherapeutic chamber (cut)

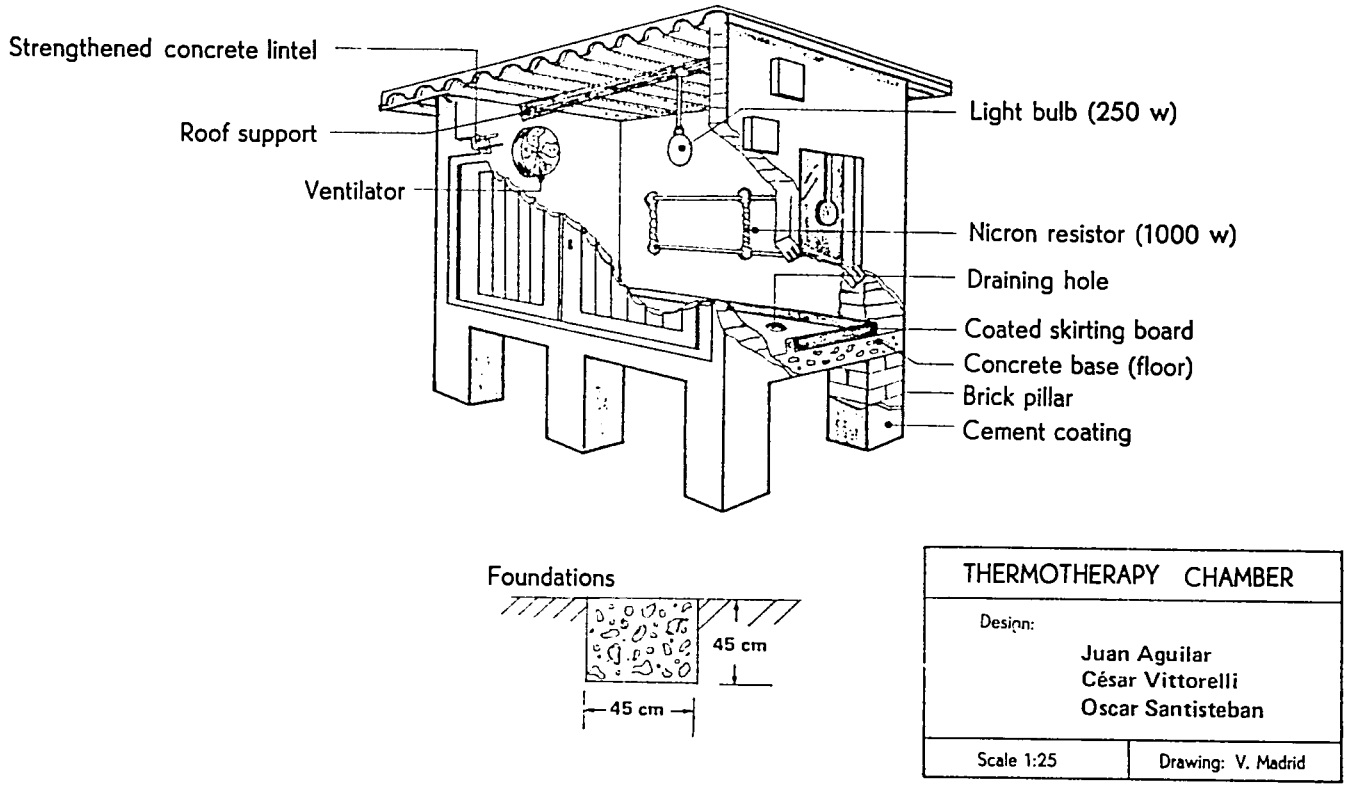
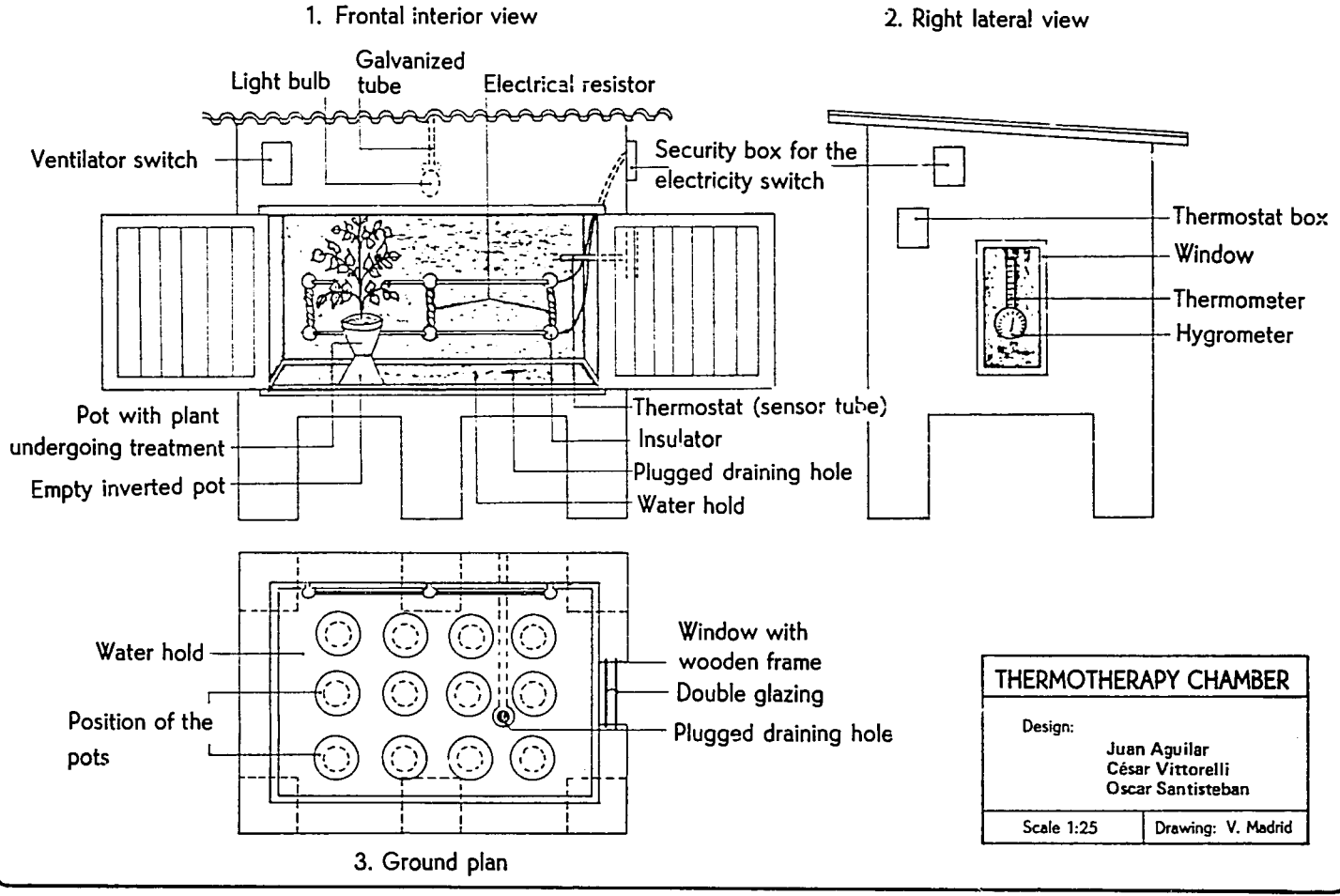


Figure 3. Thermotherapy chamber (details)



MATERIALS AND EQUIPMENT FOR THE BUILDING OF A THERMOTHERAPEUTIC CHAMBER

1. Building equipment and materials	Quantity
– 24 x 10 x 12 cm baked clay bricks	360
– Bags of cement	2
– 1/2" iron construction rod	8 m
– 1/4" iron construction rod	8 m
– Buggy type wheelbarrows of sand	4
– Kilos of plaster	20
– 1.52 x 1.10 m "Eternit" roofing	2
2. Carpentry equipment and material	
– Wooden frame 1.77 m x 1 m (thickness 7 x 6.5 cm)	1
– Tongue-in-groove type rebated doors 92.5 x 87 cm	2
– Double glazing windows with wooden frame 70 x 34 cm	1
– 20 x 15 x 10 cm wooden boxes with lid to protect switches	3
– Wooden beam for the roof, 5 x 5 cm wide, 2 m long	1
3. Hardware	
– 2" latch	3
– 4" latch	1
– 1" padlock	3
– 1 1/2" padlock	1
– 1 1/2" hinges	6
– 3" hinges	4
– Small lock with key to be built into door	1
– Aluminum bolt	1
– Metal doorknob	1

4. Electrical equipment and material	Quantity
– Small ventilator with an aluminum coil and sealed motor	1
– IMIT (Italian) thermostat, model ZM4C, 250 V, 10°C-90°C; 30 cm tubular copper sensor	1
– 20 A, 250 V main switch	1
– Nicrón Power Development Co. resistor, 1 000 W inside a 10" (250 mm) ceramic case	3
– 1.5" ceramic insulator with screws	6
– No. 8 copper wire	3 m
– 1/2 diameter spaguetti fiberglass insulator	3 m
– 2" diameter ceramic socket	1
– 1/4" galvanized iron tube	1 m
– 1/4" galvanized iron elbow bend	1
– NEOPRENE No. 16 electrical cord	4 m
– Opal light bulb, 250 W, 220 V	1
5. Registering equipment	
– Thermohygrometer (Mercury column thermometer 30°C–50°C, precision hygrometer with 100% R.H.)	1

BIBLIOGRAPHY

ARUTA M., CARLOS and FUENTEALVA A., JUAN. Obtención de plantas de papa (*Solanum tuberosum* L.) libres de virus mediante termoterapia y cultivo de meristemas. Dr. M. Roggio, 25 de Mayo 347, Of. 445, Buenos Aires, Argentina.

CENTRO INTERNACIONAL DE LA PAPA. Principales enfermedades, nematodos e insectos de la papa. 1983.

LÊ, C.L. et COLLET, G.F. Station Fédérale de Recherches Agronomiques de Changius, CH-1260 Nyon. «Methode de Combinant La Termothérapie in vitro et La Culture de Meristèmes» Premiers Résultats. Revue suisse Agric. 17 (4): 221-225, 1985.

PENNAZIO, S. and VECCHIATI, M. Potato Virus X Eradication from Meristems Tips Held at 30°C. Laboratorio de Fitovirologia Applicata de CNR, Via O. Vigliani, 104. Torino, Italy. Potato Res. 21 (1978) 19-22. Short communication.

PENNAZIO, S. and VECCHIATI, M. Potato Virus X Eradication from Potato Meristem Tips Held at 30°C. Short communication.

SCHILDE, L. and ESPINOZA, M. "Elimination of Pathogen and Storage of Valuable Clones by Tissue Culture". Lima, Peru. CIP 1981.

STACE-SMITH, R. and MELLOR, F.C. Eradication of Potato Spindle Tuber Virus by Thermoterapy and Axillary Bud Culture. Plant Pathologist, Canada Agriculture Research Station, 6660 N.W. Marine Drive, Vancouver 8, British Columbia, Canada. Dec. 1970.