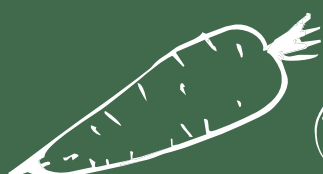
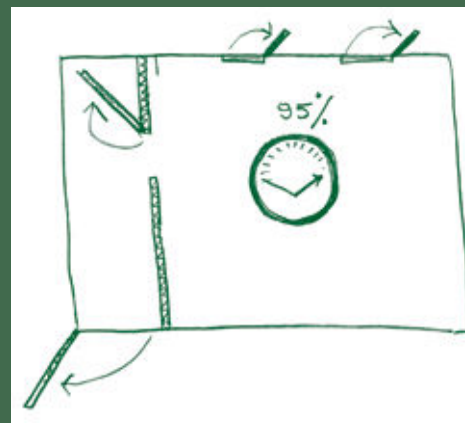




Apple and potato storage in the bioclimatic cellar

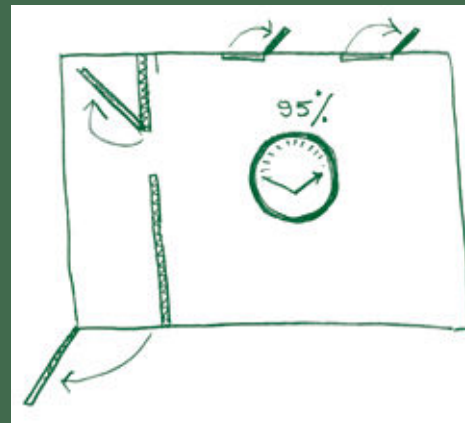
Advice for producers





Apple and potato storage in the bioclimatic cellar

Advice for producers



Apple and potato storage in the bioclimatic cellar

Advice for producers

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Ministry of Foreign Affairs of the
Netherlands

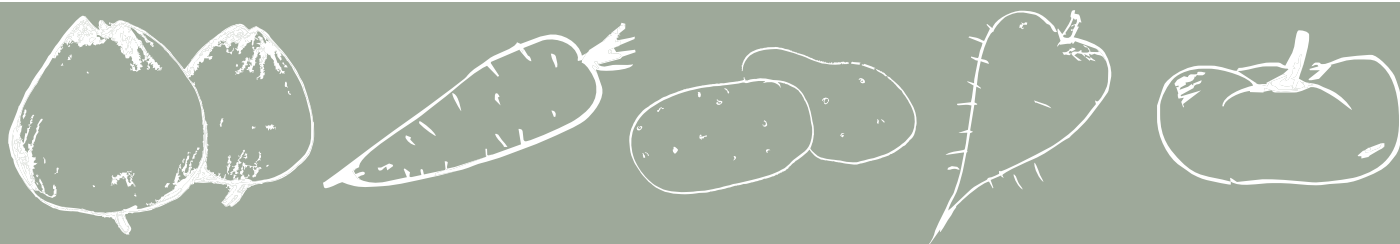


Apple and potato storage in the bioclimatic cellar

Advice for producers

geres

2013



FOREWORD

In 2011, ASDP Nau and GERES launched the construction and use of the bioclimatic cellars in Sughd province: in Fon Dario jamoat (Ayni district) and in Oshoba jamoat (Asht district). The project ended in 2013 and has supported 46 farmers in improving their storage conditions while training a total of 90 people in better storage management.

This brochure gives guidelines on how to use the cellar and how to increase the productivity and the profit from crops that can be stored.

The provided advice is based on the principles of sustainable agriculture. The aim of sustainable agriculture is to provide good quality food for people while ensuring the long-term use of the natural resources (soil, water, air).

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Sheet 1

IDEAL ROOT CROPS FOR STORING, OTHER THAN POTATOES (GREEN RADISHES, TURNIPS, RED BEETS, CARROTS)

In plain areas



green radish



turnip



red beet



carrot

I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
							←→	←→			
							←→	←→			
					←→	←→					
						←→	←→	←→	←→	←→	←→

In mountainous areas



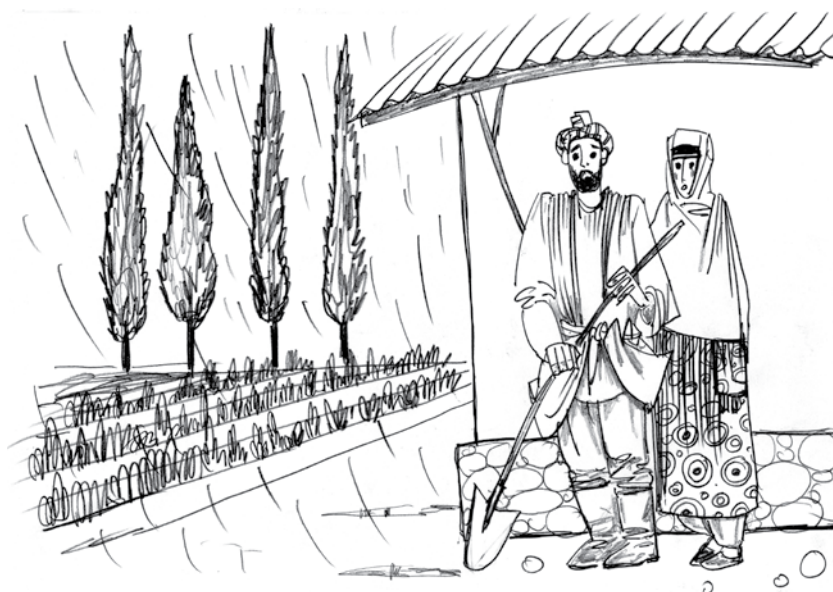
red beet



carrot

I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
				←→	←→	←→					
			←→	←→	←→	←→	←→	←→	←→	←→	←→

Successful storage is dependent on the crops being mold and pest-free.



- do not harvest vegetables after rain

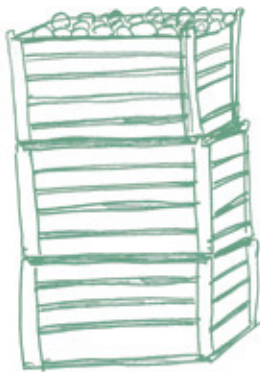
- only store healthy vegetables that are not damaged



↑
GOOD

↑
BAD

- for long term storage, put the vegetables in a box, for short term storage put them in a bag.



Sheet 2

APPLE GROWING



Upkeep of the orchard

- do a yearly pruning before the buds flower (see sheet on pruning)
- feed the tree by laying manure or compost all around the foot of the tree and incorporating it to the soil



1 - SPREAD MANURE

2 - MIX MANURE WITH THE SOIL



- it is important to treat trees and plants against diseases



FLOWER DEVELOPMENT



FRUIT DEVELOPMENT

In one season, the two crucial moments for plants and trees are flowering and fruit development

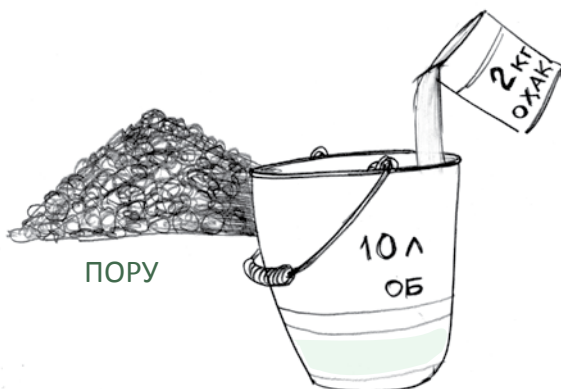
You can use pheromone traps to protect against pests.

They can be bought at Sughd Agro Service= 7-8 somonis
Put one trap for 400 to 500 m²
Use 1 or 2 days before flowering (spring).



ONE TRAP FOR 4 TO 5 SOTIK

Mix for protection against worms and heat:



Lime + fresh cow manure = mix and put on the basis of the trunk.

MANURE – 10 LITER OF WATER + 2 KG OF LIME

Determining when the fruit is ripe enough to harvest:

To determine the ripeness, there are several methods:

- count the days after flowering : 150-170 days, it can vary according to varieties
- check if the seeds inside are black
- taste
- perform a test with iodine to measure the sugar content



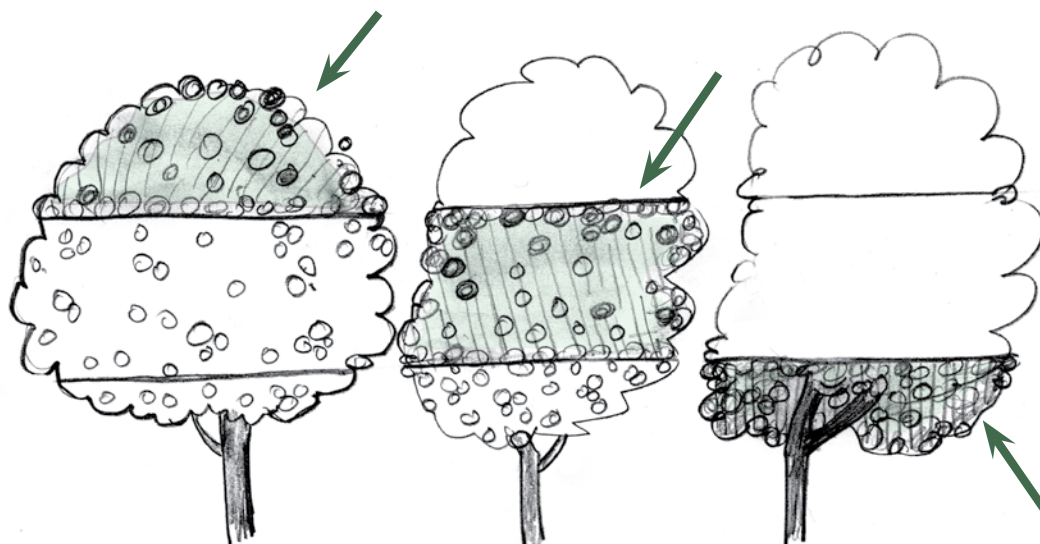
Wait for the apples to be ripe on the tree.

Harvest

Use a ladder,
Use a bag (fabric or plastic) and cut the apple stems with scissors to harvest



Harvest at 3 different times: the first harvest is on top of the tree because it is ripe earlier, then in the middle, then in the lower part of the tree.





Leave the apples in the shade and put them in the cellar in the morning after their temperature has dropped.

Sheet 3

PRUNING APPLE TREES: THE BASICS

To start with:

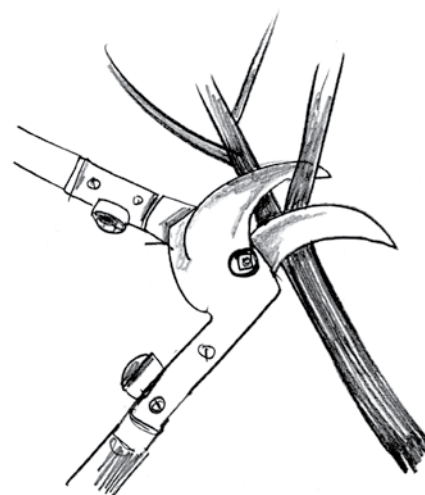
Pruning tools must be sharp and clean. If needed, you can clean the blades with alcohol. The risk of transmission of disease from tree to tree is real.

Period of pruning: in winter

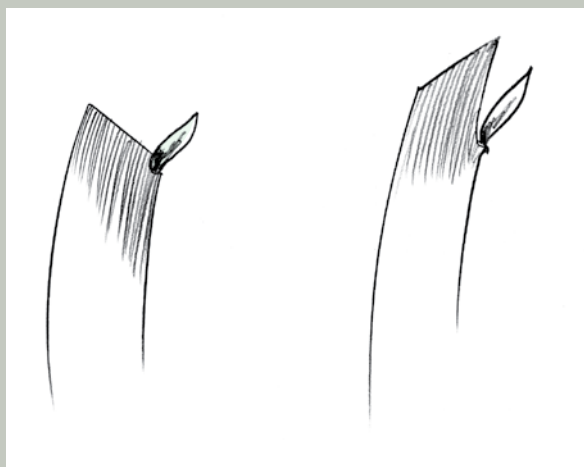
There are two types of pruning:

When the tree is young and has just been planted, pruning will give the trees' shape.

When the tree is adult, pruning will force fruit development.

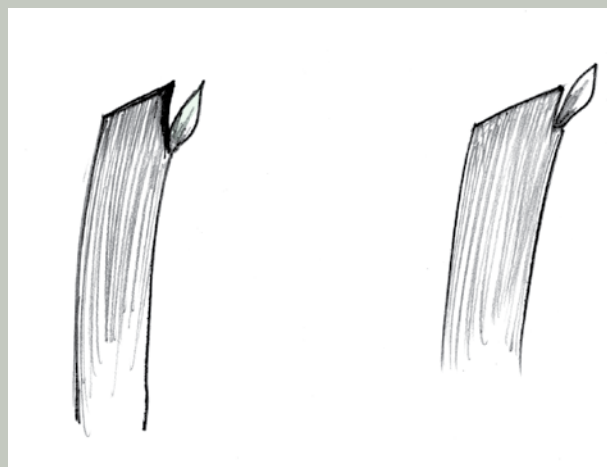


How to cut:



GOOD CUT

TOO SHORT



IN THE WRONG DIRECTION

TOO LONG

Pruning young trees

It depends on the shape you want to give the tree.

The aim is to balance the skeleton of the tree:

- cut branches that cross or that are too close to each other,
- force the development of missing branches by cutting the branch at the level of a bud that is growing in the desired direction.

Pruning adult trees:

1/ Cleaning:

- remove dead or broken branches that will smother the tree and create more shade, as well as branches that are too low on the trunk.

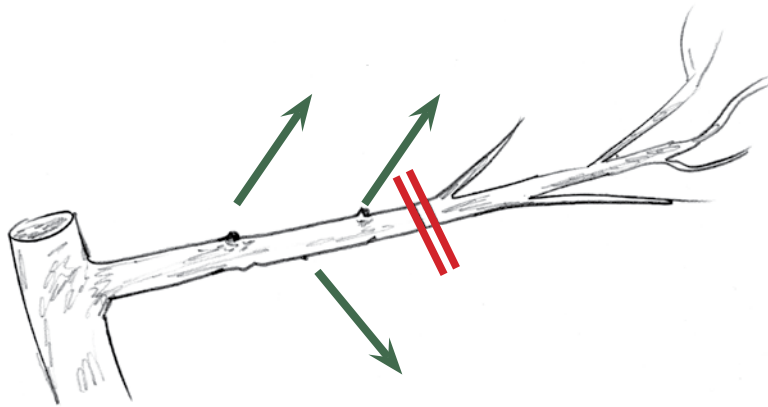
- remove branches that cross, but keep branches that are beautiful or grow in the right direction.

2/ Bring light:

- remove branches that point towards the inside of the tree (to gain light),
- remove branches that grow vertically from the trunk.

3/ Promote fruit development:

- Cut main branches so as to create new lateral branches that will be cut again so that the fruit will be closer to the trunk and thus better fed.
- prune off a third of the branches so that the fruit will receive a lot of sap and so that the tree produces a lot of buds.
- Low branches are pruned longer while branches on the tree top are pruned shorter.

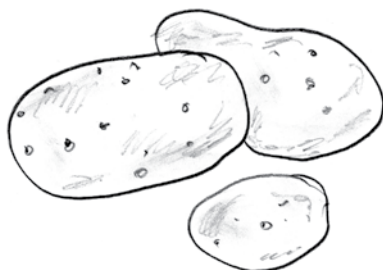


It is better to have bad pruning than no pruning at all. Without pruning, after a few years, the tree would end up giving only low-yield and bad quality harvests.

Sheet 4

POTATO GROWING

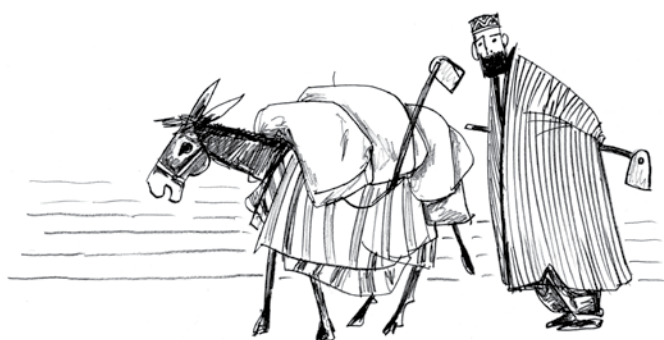
Late potatoes are the best variety for storage.



It is important to promote the exchange of seeds within different regions to keep their quality.



SEEDS EXCHANGE



ADD MANURE TO YOUR FIELD

Fertilization:

Spread compost in spring to give plants the elements and nutrients they require specifically at this time of the year. For 1ha = 10t of compost.

Or, if you have manure and no compost, spread the manure in winter so that it decomposes in the soil during the winter, thus providing the necessary elements for the plant in spring.

Irrigation

Until flowering there is no need for irrigation
At flowering time, water the potatoes.
Stop irrigating when the leaves start to dry.



CUTTING THE STEMS OF THE POTATOES



READY POTATOES



IRRIGATION

Determining ripeness

When the leaves are yellow and start to dry, the potatoes are ready to harvest.

Dig out a potato and scratch the skin. If the skin stays, the potato is ripe.

Harvest

Cut the leaf stalks at **minimum 10 days before harvesting.**

Avoid harvesting during a humid period.

Pick the potatoes and let them dry in the field under the shade.



Sheet 5

SORTING THE FRUITS OR VEGETABLES AND SETTING UP PROPER CONDITIONS FOR THE BIOCLIMATIC CELLAR

Sorting

Apples

Select and put in boxes only healthy apples without rot, damage, or worm holes.

Put the damaged apples together in boxes so that they remain easily accessible for quick sale or consumption.

Potatoes

Put healthy potatoes without rot or damage in boxes.

Put the damaged potatoes together in bags so that they remain easily accessible for quick sale or consumption.

How to store?

- boxes for apples:

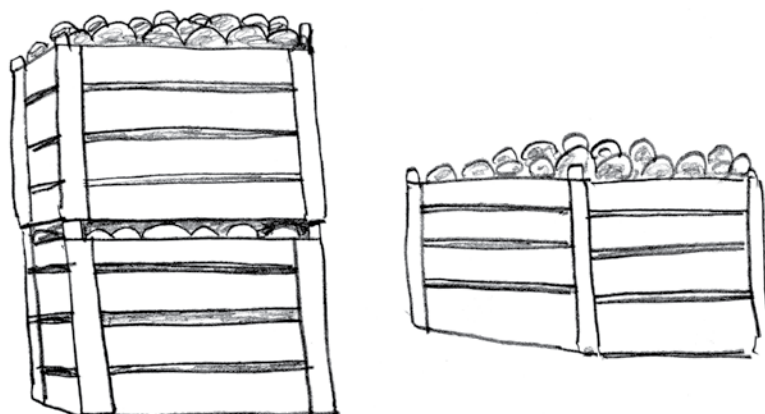
Using boxes is the best method to avoid contamination between apples.

If possible, use a wooden box, which allows air flow between the slats.

It is also possible to use cardboard with holes to allow air flow.

Put about 15 to 20kg per box for the apples.

Put paper between the layers of apples to absorb the rotten parts as they fall.



KEEP THE APPLES IN BOXES

Storing the apples in a pile on the floor does not allow for proper air flow and does not make good use of the limited space in the cellar.

To find boxes for storage, check the production of poplar boxes in your home jamoat.

Storage of potatoes is better in boxes:

From 15 to 20 kg/box.

Be aware of not putting the boxes on the holes of the ventilation pipes in the cellar.

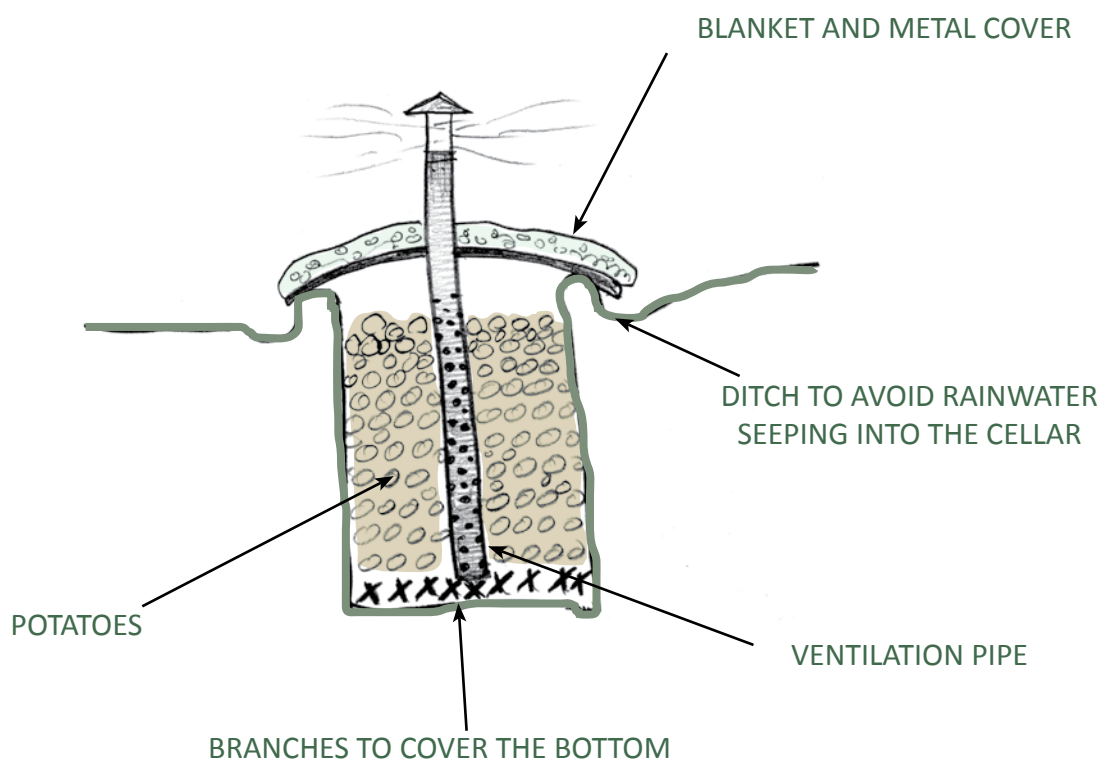
Sheet 6

STORAGE IN AN UNDERGROUND CELLAR OR UNDER THE HOUSE

For storage in the cellar, store the potatoes without putting them in a bag or a box.
If possible, add a pipe for aeration.

If ventilation is lacking, potatoes can become black and unfit for consumption and sale.

For the cellar under the house



- Insulate the potatoes as much as possible from the warmth of the house.
- Improve the ventilation of the cellar by bringing in cold air through two ventilation pipes, one located at the top of the cellar and the other at the bottom. Plug the pipes if the temperature goes below freezing.

Sheet 7

PREPARING THE CELLAR

Desinfecting the cellar

Every year it is advised to disinfect the cellar as soon as possible (May or June) to avoid diseases.

Different methods of disinfection exist:

*Lime

The cellar is whitened with lime.

This technique does not disinfect completely since it does not kill the insects in the holes of the walls.

Blue soap can be added to kill the insects that stay.

1 somoni = 1kg, available in construction shops.

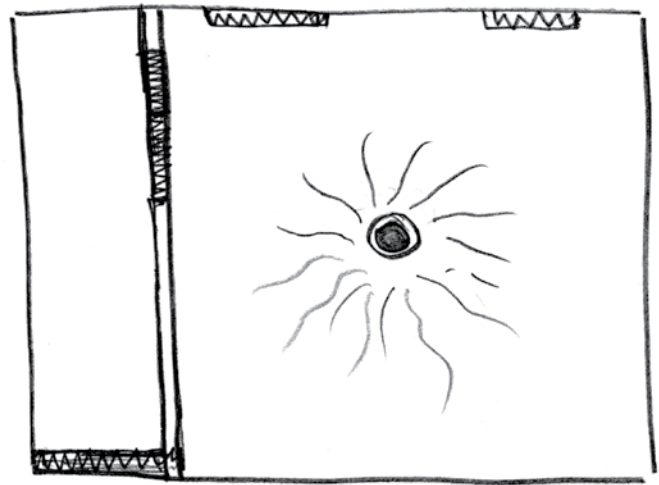


*Sulfur

Sulfur is burnt

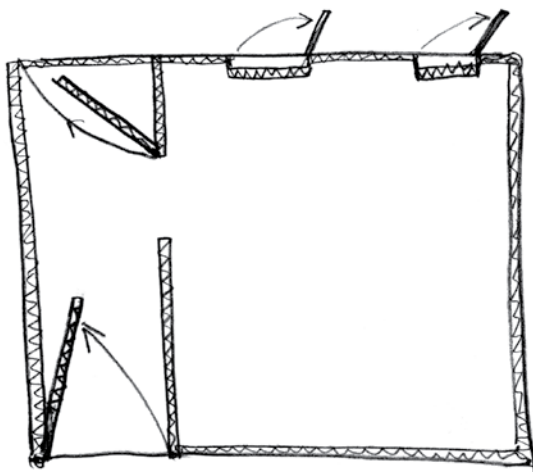


The cellar is sealed for 36 hours



CLOSE THE CELLAR FOR 36 HOURS

then opened for 4 to 5 days minimum;
it is disinfected.



It kills insects even in the cracks and holes of the walls.

Disinfect the cellar as soon as you have emptied it (after selling your crops).

If there are shelves, use sulfur.

Use sulfur for the underground cellar.

You can disinfect the boxes at the same time.

To decrease the humidity of the cellar, you can clean the walls with copper salt.

Take away and do not use any more boxes which held fruits or vegetables that were rotten.

Sheet 8

STORAGE

Put the thermometer at 1m above the soil and if possible in the middle of the cellar.



THE TEMPERATURE OF THE CELLAR
SHOULD BE BETWEEN +1 AND +5° C

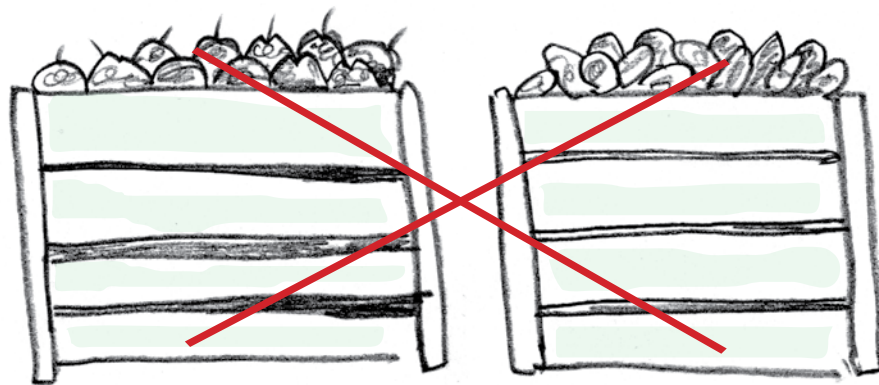
Check the status for the stored products **once a month**.

If some products get rotten they can still be used: make apple sauce with the apples for example.

Product	Temperature, T °C	Relative humidity, %	Sensitive to ethylene (apples)	Storage expectancy (months)
Potato	5 to 7	90-95	Yes	6
Potato seeds	2 to 3	90-95	Yes	6
Carrot	0 to 3	95+	Yes	> 3
Onion	-2 to 4	70	/	7
Apples	1 to 3	90-95	/	6 to 8
Beet	0 to 3	95+	Yes	6 to 8
Turnip	0 to 1	95+	no	5
Green Radish	0-2	95%	no	6
Kaki	0 to 1	90-95	no	4-5
pomegranate	> 5 to 6	90-98	no	6
Pumpkin	Mini 10 -12	70	/	4 to 6

Pumpkin : dry 15 days at 25°C.

Be careful not to mix apples with other vegetables since they release ethylene.



APPLES

POTATO

DO NOT MIX APPLES WITH OTHER VEGETABLES

Consequence of ethylene on potatoes:

- shortened storage duration
 - if storing both at the same time: put the apples higher than the potatoes (since ethylene rises)
- Ideally put the potatoes in a separate storage place.

For pomegranates, put them in gravel with the calyx facing out.

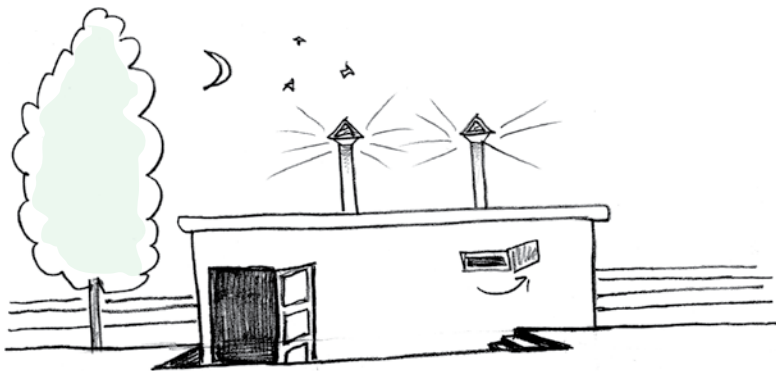
Sheet 9

MANAGING THE CLIMATE OF THE CELLAR

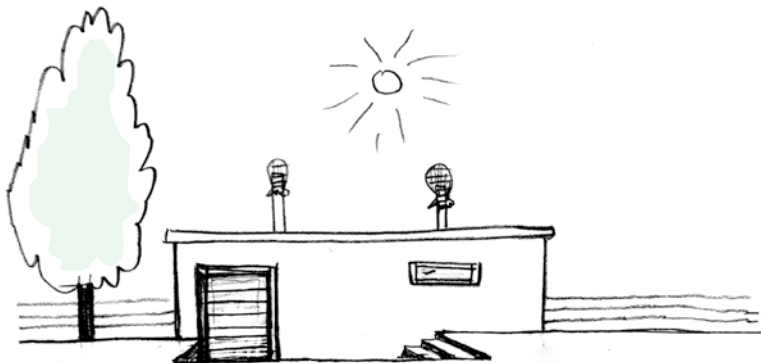
To regulate temperature and humidity of the cellar, use a thermohygrometer.

Temperature of the cellar before harvest:

Cool down the cellar by opening it at night and closing it during the day until it has reached a cool enough temperature to store crops.

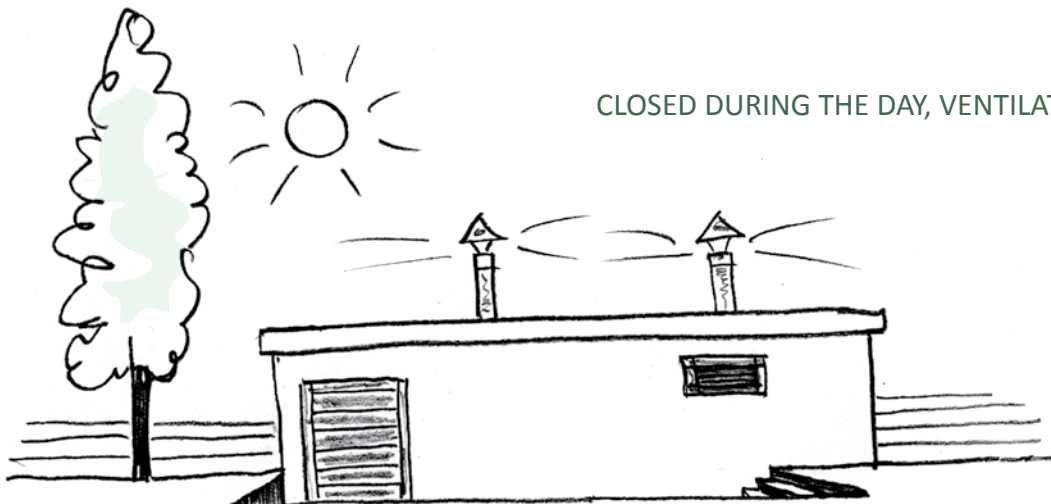


OPEN AT NIGHT



CLOSED DURING THE DAY

After harvest:



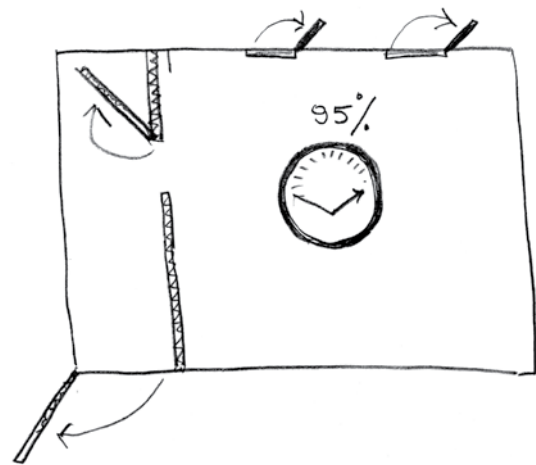
CLOSED DURING THE DAY, VENTILATION PIPES OPEN

Open the cellar during the day as long as the external temperature is cooler than the cellar temperature.

Ventilate the cellar until it reaches its optimum temperature (see table in sheet 7)
Cover the potatoes and green radish with a blanket if there is risk of freezing.

Management of humidity

During the months of October, April and May, all ventilation pipes have to be open.
In winter and spring, insure correct hygrometry by opening the pipes.
If humidity goes over 95%, open the doors (internal door and the entrance door)

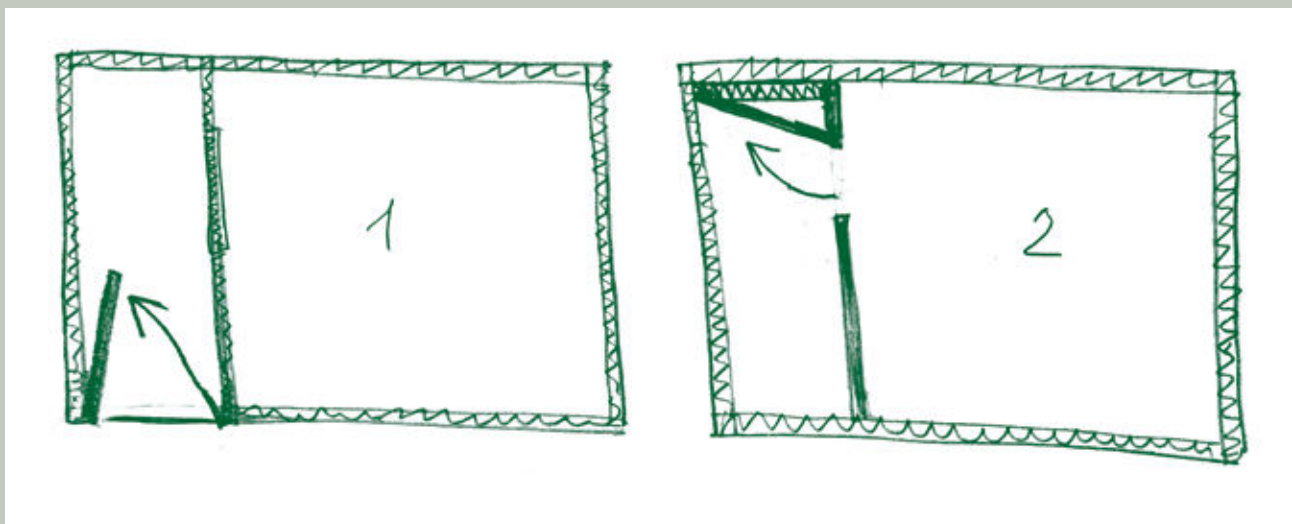


To increase humidity :

Water the soil or leave water containers in the cellar

To limit evaporation: wrap the vegetables or fruits with a cover pierced with a few holes.

Use of the double door entrance:



1 - FIRST OPEN THE OUTSIDE DOOR 2 - CLOSE THE OUTSIDE DOOR AND OPEN THE SECOND DOOR

Open only one door at a time!!!

Sheet 10

STORAGE PROBLEMS: DISEASES AND PEST

The main problems are fungi and pest.

Fungi: botrytis, sclerotinia, Rhizoctonia

Fungi develop when the cellar is hot and humidity high.

If fruits are damaged, the fungi will develop on the damaged zone.

If there are burns or black dots on the skin, it is sclerotinia or Rhizoctonia (dry spots).

If there is a significant change in temperature, the inside of the apple can become transparent.

Sanitary followup

Every month, check a few boxes from different areas in the cellar.

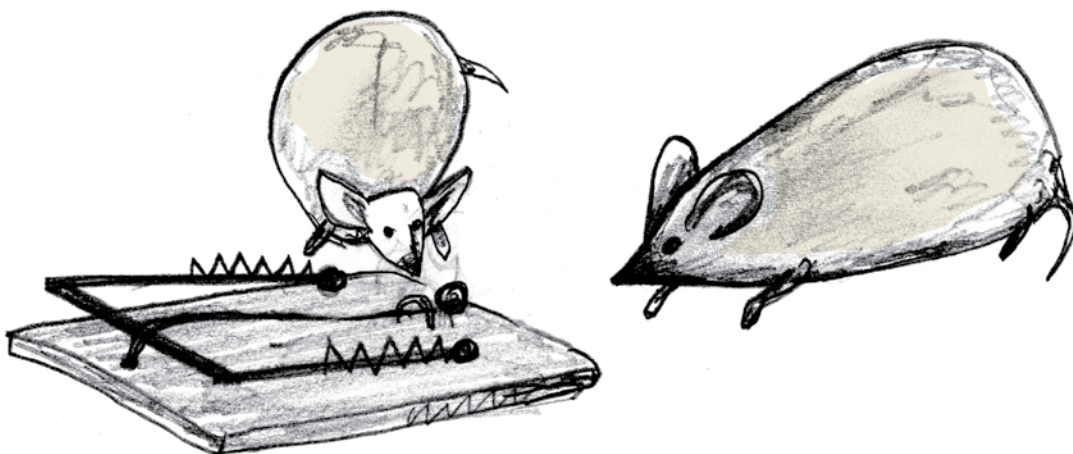
If there is a lot of disease or fungi, check the whole stock.

- Remove the rotten products,
- Check the potatoes because they freeze very quickly during frost.

Methods to reduce pests

For mice and rats, use mechanical methods and avoid poison which is dangerous for humans to ingest.

Close the cellar carefully to prevent pests from entering it.



MOUSE TRAPS

Sheet 11

BUSINESS PLAN FOR VEGETABLE AND FRUIT STORAGE



How to use this business plan?

- write down each type of vegetable and fruit in the cellar
- Detail the variety, the quality and the stored quantity
If the fruits or vegetables are sorted by quality, you can write, for example:
Apples, variety "semirinka", first quality
Apples, variety "semirinka", second quality
- write down when you hope to sell the fruits or vegetables (which month)
think and discuss about the storage duration: Is it improved with the cellar ?
* If you sell a little each month, write down each month
- write down the percentage of crop loss that you are expecting
!! be careful it might increase with the storage time!!
- calculate with the stored quantity and the loss percentage, the final quantity available for sale
- write down the price that you are expecting
* think about:
 - can you ask a better price according to the type of client?
 - how to get informed about the prices in town ?
 - will selling in bulk and in bigger quantities (gathering the productions of several farmers at the same time for example) allow you to reach other clients?

- write down different prices if you sell at different months.
- write down the type of client (buyer who comes to your place, at the bazar, a reseller, neighbours)
If there are several clients, write them all down.
- calculate the final income per product.
- calculate the total income for the cellar.

PROPOSITION OF INTERNAL DESIGN FOR 4 TON BIOCLIMATIC CELLAR



As much as possible, avoid direct contact of the fruits or vegetables with the wall.

YEARLY INCOME WITH THE NEW CELLAR : YEAR 2011-2012 OR 2012-2013 OR 2013-2014

Type of vegetable or fruit	Variety	Quality	Stored quantity(kg)	Month of sale	% of expected loss	Final quantity to sell (kg)	Expected price (somonis)	Expected client	Sale income (somonis)
Total yearly sale income									

CHARGES

		somonis	Total initial investment (somonis)
Initial investment	Total cost of building the cellar		
	Cost of inside equipment (boxes, shelves...)		
		Somonis/year	Total yearly charges
Yearly maintenance cost	Renting of a vehicle for transportation		
Transport costs for sale	Fuel costs		
	Fuel costs		
	Other costs		
	Other costs		

CALCULATION OF THE YEARLY NET PROFIT

Total net profit: Total yearly income of sales – total yearly charges =	
Payback period on investment (years)	



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