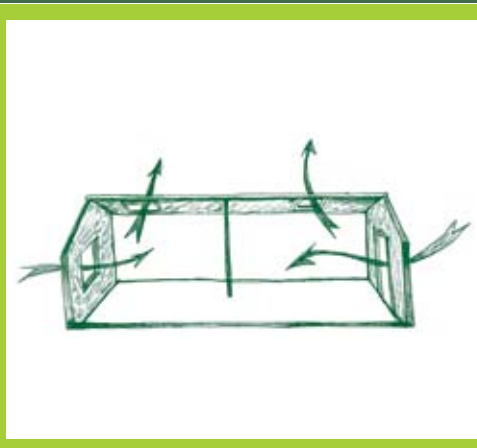
Vegetable production in a solar greenhouse

Advice for producers



Vegetable production in a solar greenhouse

Advice for producers

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2013

Dushanbe - 2013

FOREWORD

In 2011, ASDP Nau and GERES launched a project to promote the construction and use of greenhouses in Sughd province: the target areas of the project were in Fon Dario jamoat (Ayni district) and in Oshoba jamoat (Asht district). The project ended in 2013 and has supported 87 farmers in building greenhouses and training them for off-season production of vegetables.

This brochure gives guidelines on how to use the greenhouse, what to grow, and how to follow the crops so as to enable farmers to sustain their business.

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 natural resources (soil, water, air).

CONTENTS

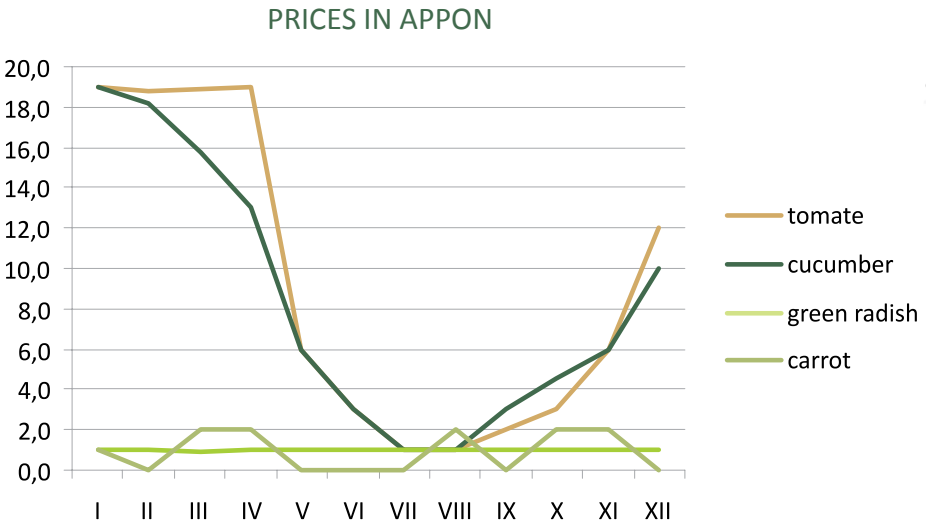
Sheet 1 CHOOSING YOUR CROPS IN ORDER TO MAKE A PROFIT

The choice of crops will be made first according to the price of selling when the crops are ready for harvesting. Crops that sell at a higher price are given first priority.
It is important to be sure that the crops can be sold at a high price.

Next you should check if it is possible to grow these vegetables in the greenhouse according to the temperatures that they require.

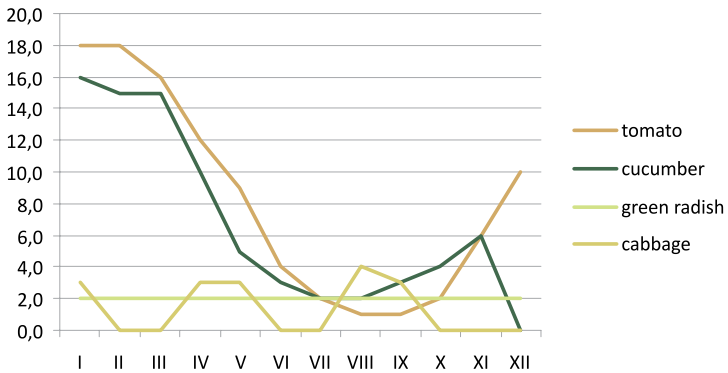
1. Prices of vegetables

a/ Prices of vegetables in Appon Bazaar over one year (2012)

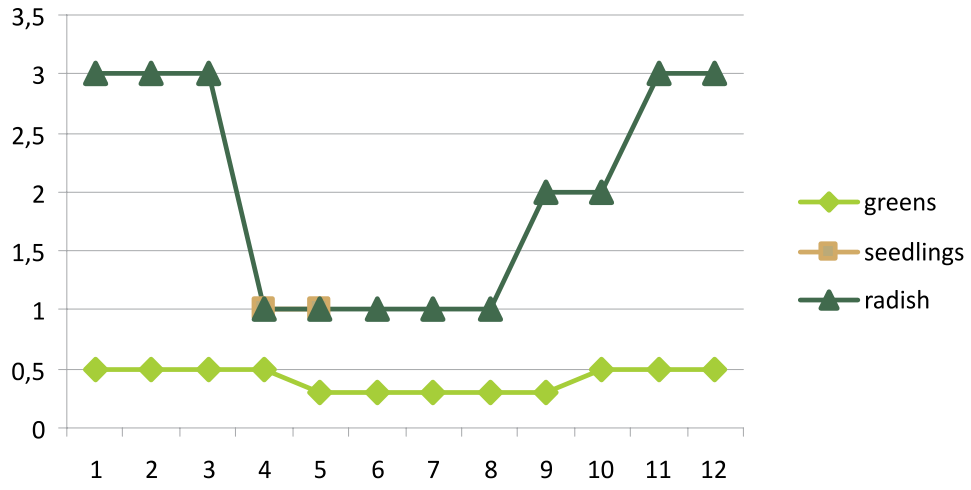


b/ Prices of greens in Appon over one year (2012)

c/ Prices of tomatoes and cucumbers in Sarvoda over one year (2012)



PRICES IN SARVODA



2. Temperatures in the greenhouse

The greenhouse provides a temperature difference of +10°C compared to the external minimum night temperature.

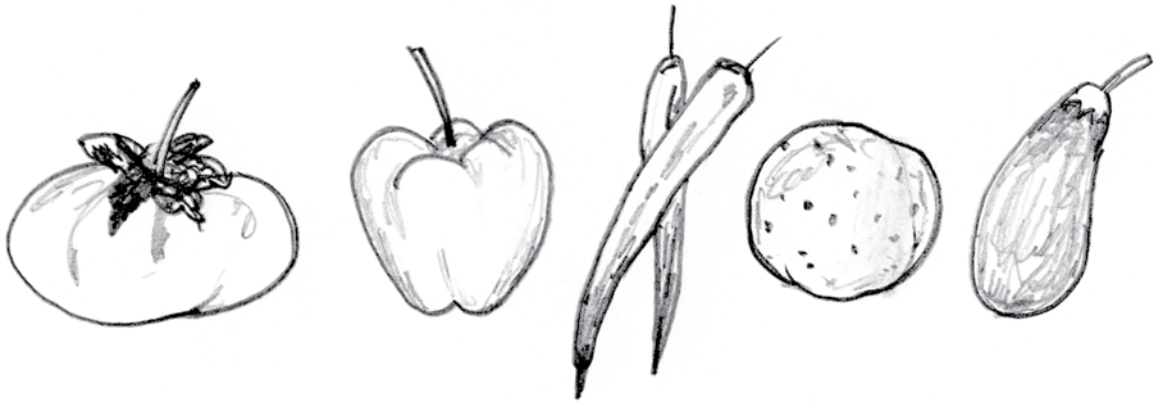
The use of the night cover provides a temperature gain of at least 3 more degrees Celsius.
Calculate the temperature on the inside of your greenhouse to determine what crops you can grow in it.

3. Ideal temperatures for selected vegetables

	Tomato	Cucumber	Aromatics and herbs, radishes
Soil temperature for germination	25°	25°	8-12°
Temperature under which the vegetable stops growing	12°	12°	0°
Average ideal temperature	Night: 13° Day: 25°	Night: 20° Day: 23°	15-18°

Sheet 2 DESIGNING YOUR CROP PLAN

First of all, you should be able to know and recognize the different families of vegetables:

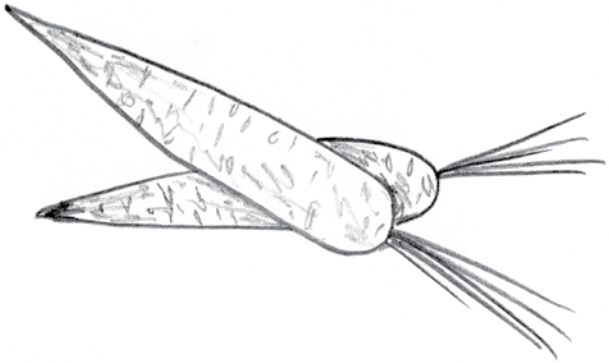


Solanacea: tomato, belt pepper, chili pepper, potato, eggplant.

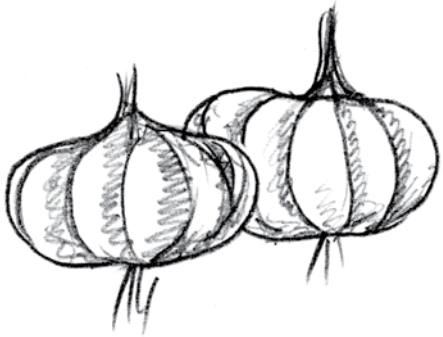
Cucurbitaceae: cucumber, pumpkin, watermelon, melon.

Brassicaceae: cabbage, green radish (turp), red radish, rape, turnip.

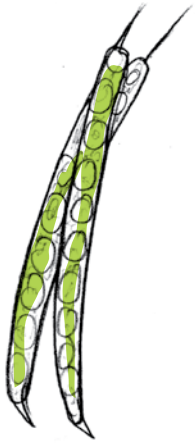
Chenopodiaceae: beet, spinach.



Apiaceae: carrot.

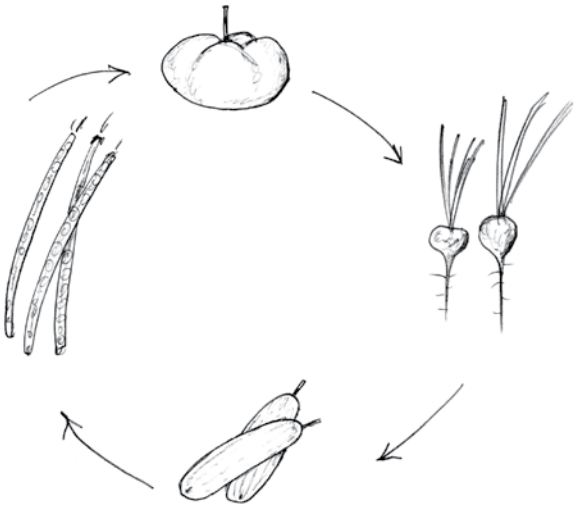


Amaryllidaceae: onion, garlic.



Fabaceae: bean, broad bean, mung bean, chickpea.

The principle of crop rotation is the following:



Check that 2 vegetables of the same family don't follow each other,
Look at the part of the vegetable that is harvested: don't grow two root vegetables or two fruit vegetables one after the other,
Avoid growing 2 families of vegetables that have high fertilization needs one after the other.
The families that have high fertilization needs are the Solanaceae and the Cucurbitaceae.

3 principles should be followed to design the crop planning:
- respect the principle of crop rotation,
- check that climatic conditions are favorable for the crop (warm enough),
- check that the crop brings some financial value.

Example of a 3 year crop rotation:

In a mountain climate or in a climate with severe cold winters (minimum temperature in winter below < 15° C)

year	crop	VIII	IX	X	XI	XII	I	II	III	IV	V	VI	VII
1	tomato	+	+	+	+								
	radish				+	+	+	+					
	cucumber							+	+	+	+	+	
	green manure (sorgho)										+	+	+
2	green radish	+	+	+									
	greens				+	+	+	+					
	tomato							+	+	+	+	+	
	green manure (sorgho)												+
3	cucumbers	+	+	+	+								
	radish/seedlings				+	+	+	+	+				
	spring cabbage							+	+	+	+	+	
	no green manure												+

In a climate with mild winters (in Asht):

year		VIII	IX	X	XI	XII	I	II	III	IV	V	VI	VII
1	tomato	+	+	+	+	+							
	radish						+	+	+				
	cucumber							+	+	+	+	+	
	green manure (sorgho)											+	+
2	green radish	+	+	+	+	+	+	+					
	greens							+	+	+			
	tomato										+	+	+
	green manure (sorgho)												+
3	cucumbers	+	+	+	+	+	+						
	radish/seedlings							+	+				
	spring cabbage							+	+	+	+		
	no green manure												

Sheet 3 CHOOSING YOUR SEEDS

Thoroughly familiarize yourself with the following information:

- name of the variety:
Write it down on your agricultural plan to remember it. If the plant is well adapted to its agricultural surroundings you can plant it again, and if it is not, you will know to avoid planting it in the future.

- characteristics of the variety:
* early, for an open field, or for a greenhouse
* hybrid (obtained through crossing, produces seeds which are not fertile)

- expiration date

- chemical treatments
Treatment with thiram: forbidden in organic agriculture according to European standards

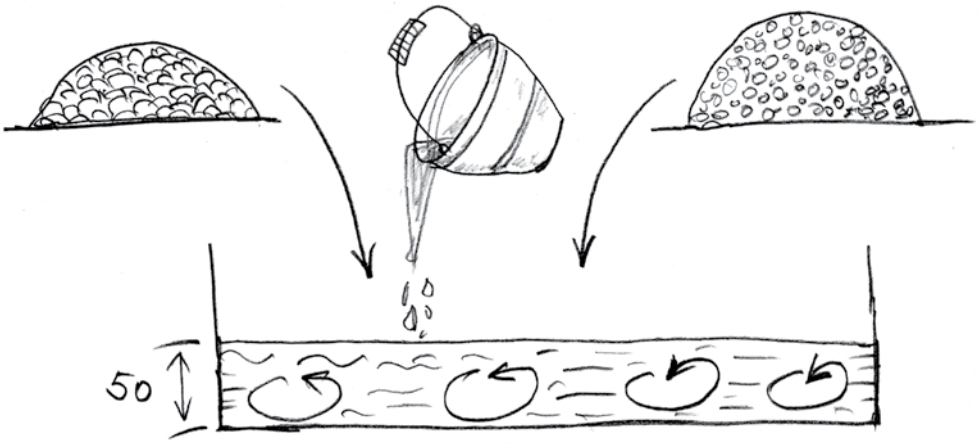
- resistance to various viruses (CMV: Cucumber Mosaic Virus, mildew on tomato…)

Sheet 4

RESTORING THE SOIL AFTER BUILDING A GREENHOUSE

After excavating 50 cm, the soil can be restored for the crops with:

- 50%: extracted soil, of which the biggest rocks will be removed.
- 50%: mature compost



Mix well,
Recreate a 50 cm layer,
Water enough so that the soil stays humid on the surface for 2 days: check with your hand that the soil remains wet.
Let it rest for 4 to 5 days before planting the crops.

The soil will only become efficient after 2 to 3 years.
Once the soil is constituted, it will be the base for future crops.
If the soil is managed well you will not need to replace it.

Good maintenance means ensuring good crop rotation, and a limited input of organic and mineral matters.

If the soil has a severe disease, it is better to disinfect it through solarization (see sheet on solarization), than to remove the soil completely.

To prepare the soil for sowing or transplanting, loosen the top 10 cm of soil with a pickaxe.

Sheet 5

ONE YEAR BUSINESS PLAN FOR VEGETABLE PRODUCTION IN A GREENHOUSE

Cultivated area of the greenhouse in m²:

1. Cultural plan over one year

months		VIII	IX	X	XI	XII	I	II	III	IV	V	VI	VII
Crop 1													
Crop 2													
Crop 3													
Crop 4													

2. Charges

Running of the crops

	Crop 1	Crop 2	Crop 3	Crop 4
Seed quantity needed for sowing (g)				
Price of seeds (TJS/g)				
Kg Fertilizer 1 needed for 1m²				

Total kg of fertilizer 1 over one cycle				
Price of fertilizer 1 for one cycle				
Kg of Fertilizer 2 needed for 1m²				
Total kg fertilizer 2 needed over one cycle				
Price of fertilizer 2 for one cycle				
Price of phyto sanitary products				

Inputs costs

	Crop 1	Crop 2	Crop 3	Crop 4
Total seeds cost				
Fertilizer 1 cost				
Fertilizer 2 cost				
Total cost of phyto sanitary products				
Polyethylene cost (TJS/year)				
Water cost (TJS/ year)				
Drip irrigation paying off (TJS/ year)				
Tools costs (TJS/ year)				

Other costs

Payment for work (TJS/year)	
Land tax (TJS/year)	
Other costs related to greenhouse production (TJS/ year)	

3. Marketing your products?

Where can you sell your crops?		-
Cost of transportation for selling		somonis/month
Other marketing costs		
Total marketing cost		Somoni/year

4. Total costs

Input costs		somonis/year -
Other costs		somonis/year
Marketing Costs		somonis/year
Total costs		somonis/year

5.Income from production

	Crop 1	Crop 2	Crop 3	Crop 4
Number of plants/ density per m²				
Harvest (kg/plant or kg/m²)				
average selling price (TJS/kg)				
Income From production (TJS)				
Total income				

6. Profitability of your business

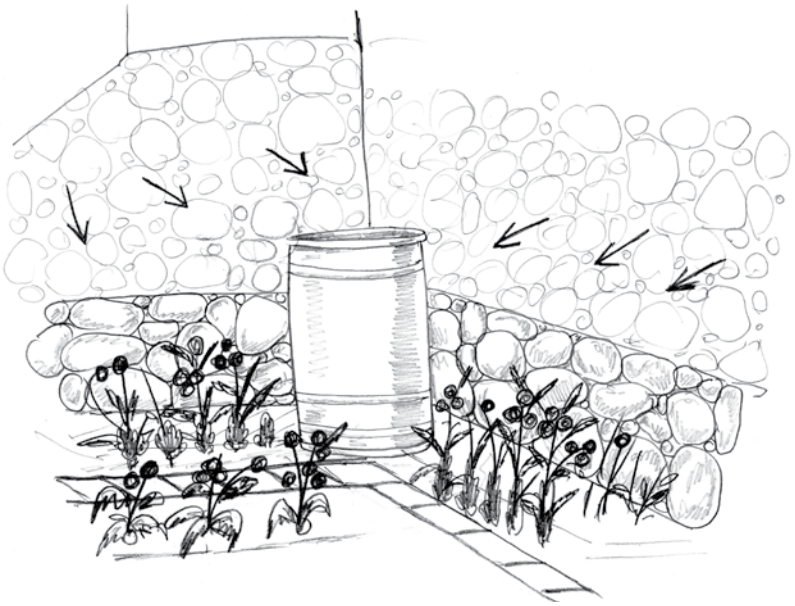
INCOME-CHARGES		**Somoni/year**

Conclusion

Is your business profitable?

How can you make it more profitable?

Sheet 6 ORGANIZING A GREENHOUSE



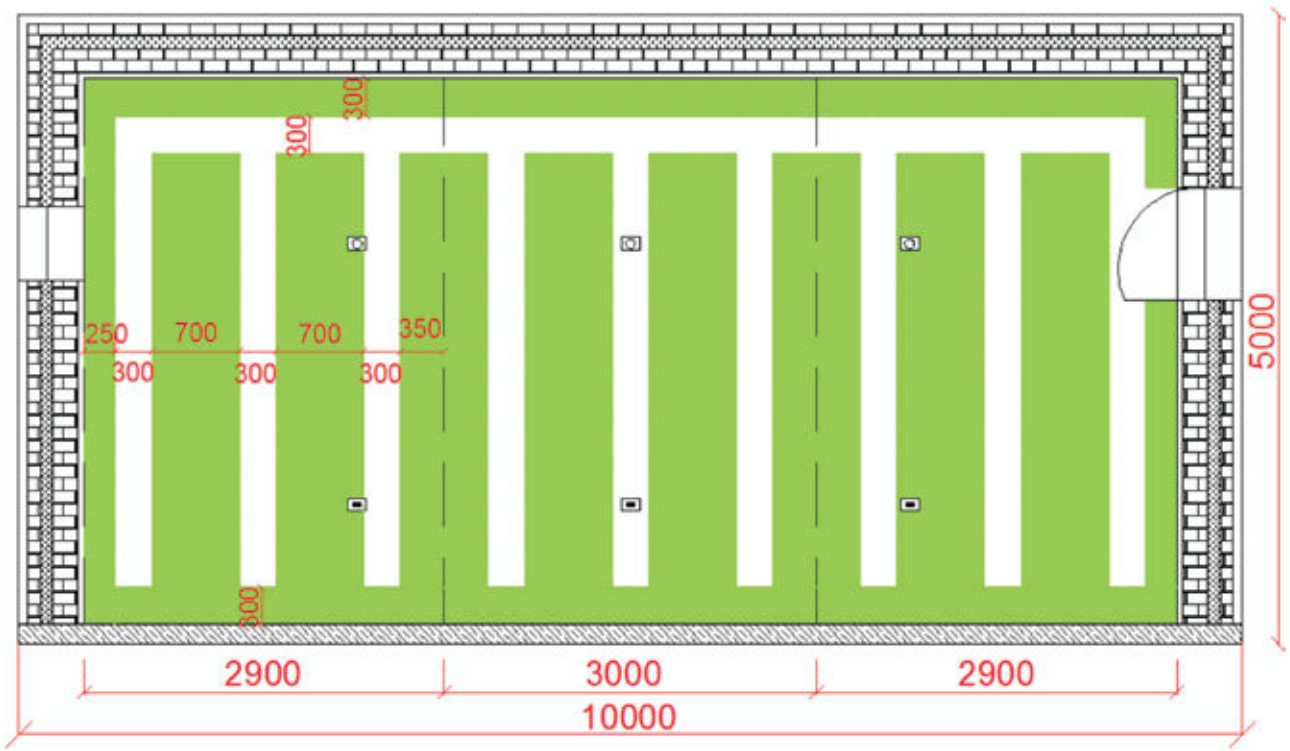
Following principles:

- Take advantage of the heat emitted by the walls by planting at the foot of the walls.

- Minimize the walking area.

Example of how to organize a greenhouse:

Making planting rows of 70cm width allows for good density of plants. There will 2 lines of plants separated by 70cm.



The green indicates the planting area and the white the walking area.
You can add a water reservoir in a corner of the greenhouse.

Put the thermometer 40 cm above the ground on a beam in the middle of the greenhouse.

Sheet 7

HOW TO MAKE COMPOST

Advantages:

Compost is a fertilizer which provides ready nutrients for the plants while providing long-term beneficial effects on the soil. It gives the soil good structure and helps it retain water.
The process of composting kills disease, pests and weed seeds in the manure.

How does it work?

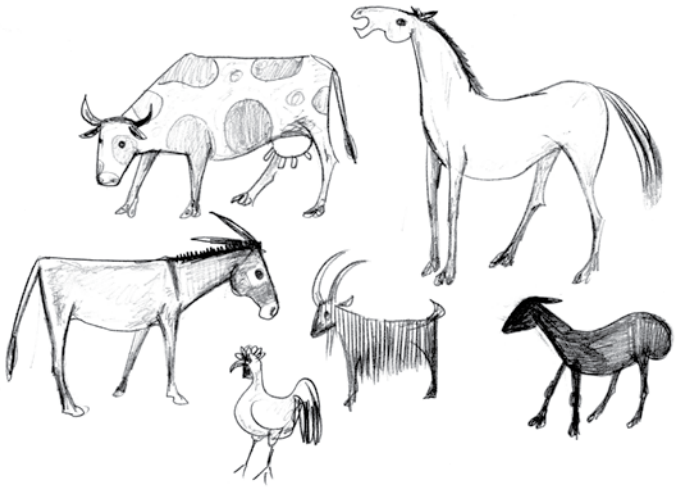
Compost is the decomposition by fungus and micro organisms of vegetable matter to create humus.
Compost is used as the main fertilizer for all crops and as humus to start seedlings.

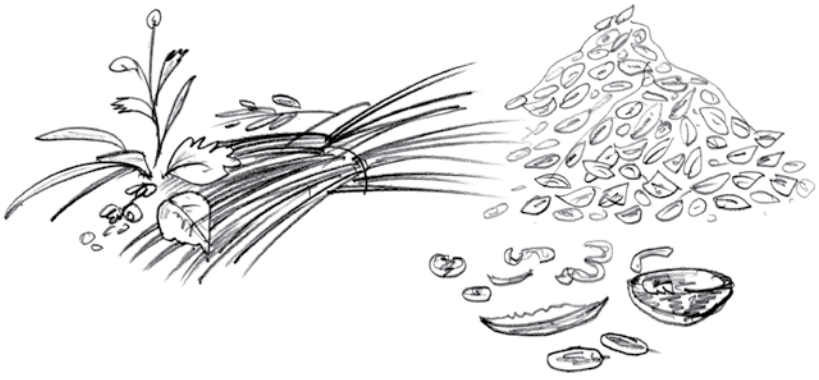
To make compost :

Dig a pit :
depth 1 m, width 1m, length 1,5m

Use:

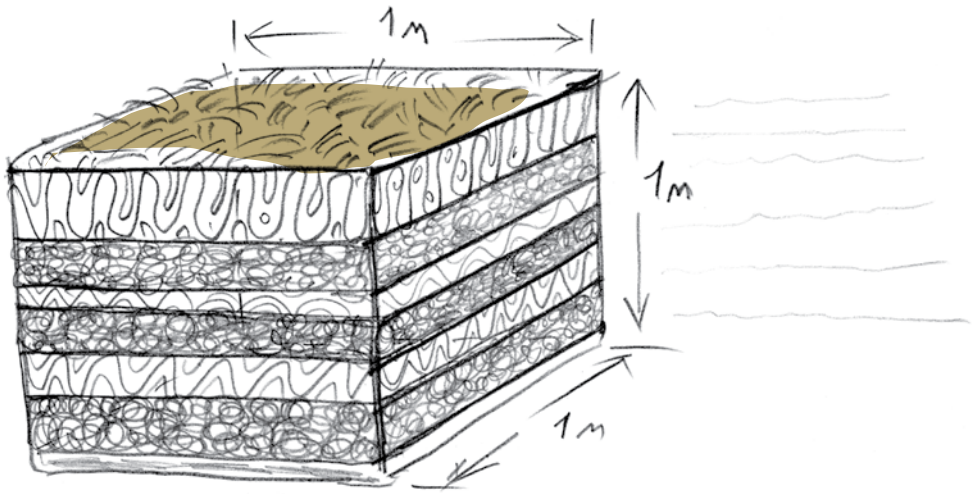
- manure (cow dung, sheep and goat dung, donkey dung, even mixed with hay from the shed)





- vegetable waste of small size : fallen leaves from trees, old hay, twigs, sawdust, kitchen waste (peeling from vegetables).

Vegetable waste should represent between 20 and 40% of the total volume of compost, it may vary according to the total amount of hay in the manure.

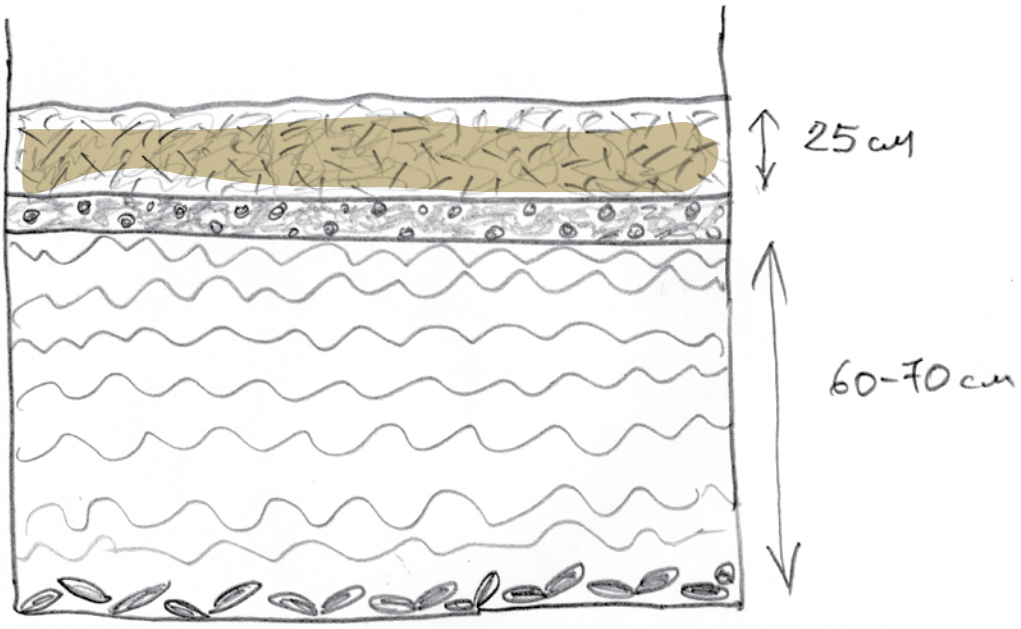


Lay down one layer of manure, add a layer of small vegetable waste, add another layer of manure. Water and cover with polyethylene.
Let it fully decompose from March to October. It is advised to take everything out at once and mix it.

Compost is ready when:
- it does not smell any more,
- it looks like dark crumbly soil.

If more materials are available to make compost in autumn, it is possible to empty the pit and store the ready compost in bags. Then store it in a cool, not too dry place.
Finally, prepare some new compost that will be ready in the spring.

Sheet 8 MAKING A HOTBED



It is preferable to use horse manure (which warms up the most).

Proportions: if the manure contains hay and dry matter, you should add some wet matter (fresh herbs, kitchen waste).
It should contain 2/3 of manure and 1/3 of wet matter.
Be careful not to water too much, the mix should be humid but not too much.

Height of the hotbed: the thicker it is, the more heat the hotbed will keep.
Do not pack the hotbed too much.
It is possible to put a layer of soil on top or to directly put the cups of the seedlings so that they benefit from the heat.

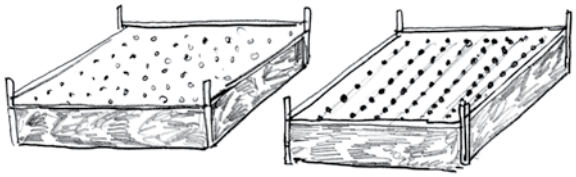
The temperature must go up quickly (within a few hours).
If the temperature has not increased after a half-day, there is a problem of proportions, humidity or air.
The hotbed will heat for 2 to 3 weeks, then the temperature will go down progressively.

The remains: it will be half-matured compost

2 options :
- Continue the process of composting by covering with a tarpaulin (to avoid losing all nutrients because of leaching or having it dried by the sun).
- Use it for fertilizer-demanding vegetables not by mixing it into the soil but by raking it onto the surface.

Sheet 9 GROWING SEEDLINGS

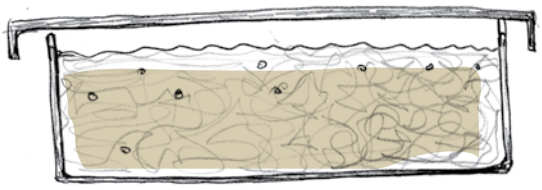
Sowing:



BY SCATTERING SOWING IN LINE

IN CUPS
(MADE WITH PAPER, CARTON, RECYCLED PLASTIC CUPS)

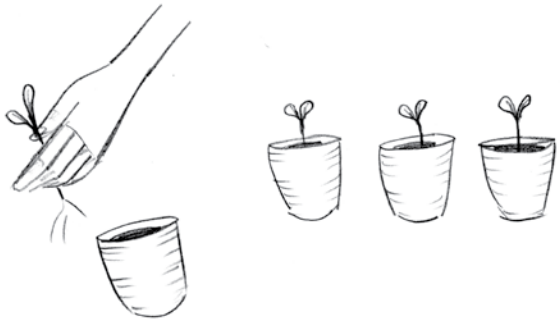
- In a box:
- Prepare the soil for the seedlings by mixing compost (70%) and soil (30%).
- Put this mix in a box.
- Fill up to 2 cm from the top of the box.
- Sow and cover with 0,5 cm of this soil and compost mix.



- Water carefully, cover with the plastic and put the box at the necessary temperature for the crop.

- As soon as the germination has started and the plantlets start sprouting out, take the plastic cover out.
- Put it under some light until the plant is ready for transplanting.
- Keep the soil humid.

Transplanting

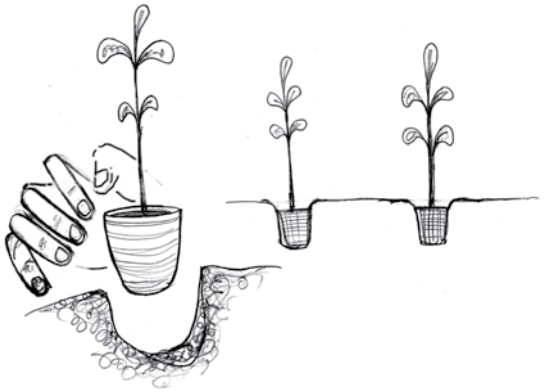


Avoid watering the box before transplanting.
Before transplanting, prepare the cups: fill them with the mix of compost and soil.
Then with a small spoon, make the soil crumbly to be able to take the plantlet without damaging its roots.

Make a first hole with your little finger.
Insert the plantlet carefully and squeeze the soil around it by compacting it.

Transplanting into the soil

Avoid watering the cup before transplanting.
Loosen the soil and prepare small holes to put the plantlet into.
Pull out the plant with the root ball from the cup if it is not made of paper.



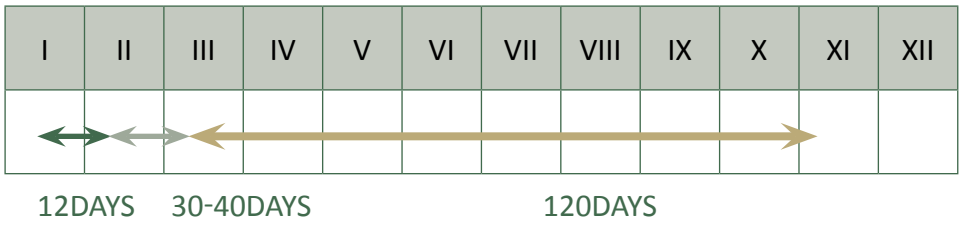
Be careful not to damage the roots and to keep the entire root ball.
Put the root ball in the soil and pack the soil around the root ball so that the roots are in contact with the soil.

Water generously without drowning the plant

To sow plants directly into cups (cucumber, belt pepper, melon, pumpkin, cabbage, flowers with big seeds)

Make a mix soil + compost.
Put the seed in the cup. Put it at a maximum depth of 1 cm.
Cover with 0,5 cm of the mix soil + compost.
Water.
Cover with a plastic sheet to facilitate germination. Take away as soon as the plantlet appears.
Transplant in the soil when it is ready.

Sheet 10 TECHNICAL ITINERARY FOR TOMATOES IN A GREENHOUSE

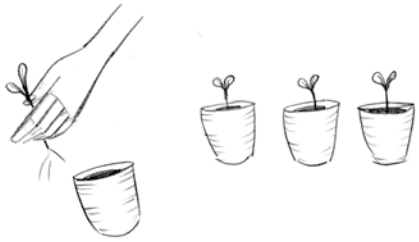


The first transplanting from the box to the cup should happen 12 days after sowing.
The second transplanting from the cup to the ground happens 30 to 40 days after the 1st transplanting.
Harvest occurs 110 days starting from sowing time and this might vary according to varieties.
The harvest lasts from 60 to 120 days.

Sowing

Depth sowing = 0,5 cm

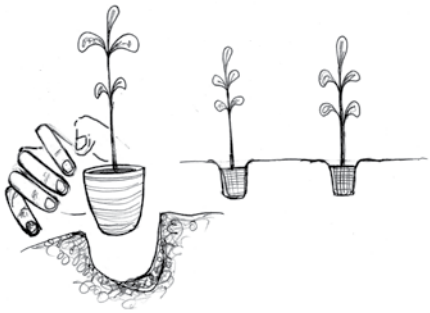
The right temperatures for germination are the following: soil = 25°C, air = 18-20°C



First transplanting: from the box to the cup

The first transplanting (from box to cup) occurs when there are 2 cotyledons (the first two leaves).

The temperatures should be as follows: T° soil = 15-20°C, T° air = 15°C at night, 20°C during the day



Second transplanting : from the cup to the ground

The 2nd transplanting happens when the seedling has 3 real leaves (without counting the 2 cotyledons) and when the first flower appears.

The temperatures should be as follows: T° soil = 20°C, T° air = 13°C night, 25°C during the day

The density of transplanting is 4 plants/m²
Between each row = 70 cm
Between each plant = 50cm

Fertilization

Spread compost on all the surface = 7 kg/row
Put manure in the row when you transplant tomatoes.
Mix with the hoe down 10 to 15 cm.

Transplant the seedlings.
After transplanting, it is possible to make a furrow that goes up to the first leaf if you did not transplant deep enough.

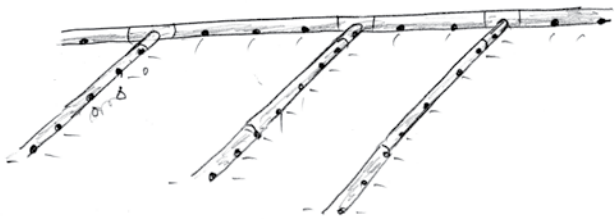
Propping up the plant with a string support

Before putting the plant around the string, the plant should be well rooted (21 days after transplanting into the soil).

Irrigation

Irrigate every 2 days to keep the soil humid but not wet.

With drip irrigation, it should not drip directly at the foot but 10 cm away to avoid asphyxia of the plant.

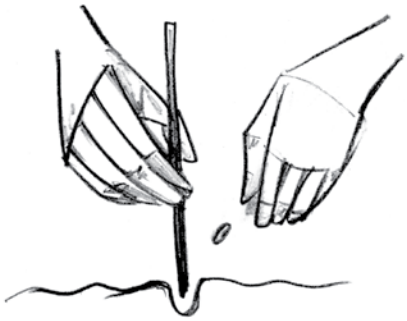


Sheet 11

TECHNICAL ITINERARY FOR CUCUMBERS IN A GREENHOUSE

I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
	↔	↔	→	→	→		↔	→	→	→	
	EARLY CUCUMBERS						LATE CUCUMBERS				

There are two interesting cycles for cucumbers in a greenhouse:
- early cucumbers that will be harvested in May and June
- late cucumbers that will be harvested in October and November.

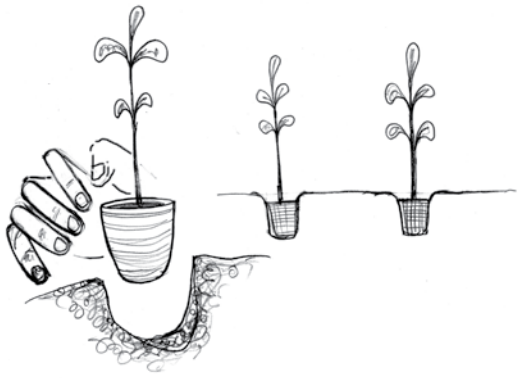


Sowing directly in cups

Sow at a depth of 1 cm,

The temperatures for germination should be the following:
soil T°= 23-25°C, air T°= 23° (28°C is the optimum air temperature).

Once seeds have germinated, the air temperature should drop to 23°C.



Transplanting (from cup to ground)

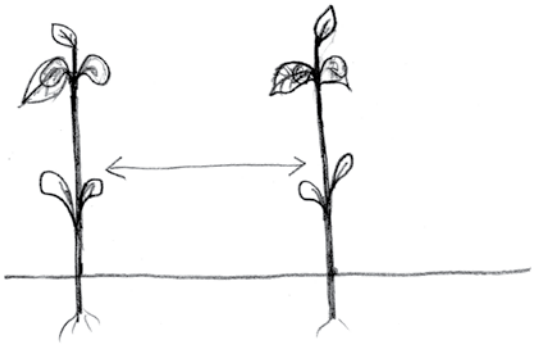
The transplanting happens 20 to 25 days after sowing, when there are 2 cotyledons.

The right temperatures for transplanting are:
T° soil 21°C, T° air= 20-21°C at night, 23°C during the day.

Transplant the clod without burying the cotyledon, while being cautious because the plant is fragile.

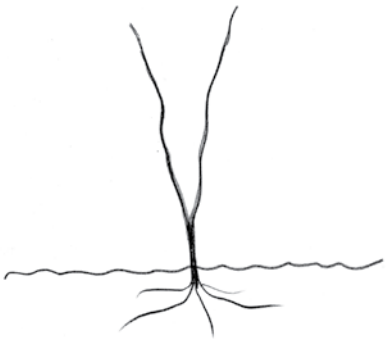
Preparing the transplantation:

Spread compost on all growing surface with 7kg/row. Incorporate in the soil down 10 cm.



Density of cucumber = 70 cm x70 cm.

Keep two branches at the base for double harvesting.



Before rolling the plant around the string, the plant should be well rooted (15 days after transplanting).

Irrigation

Give the plants enough water so that the inside of the greenhouse stays humid.
Water at the foot of the plant.

The harvest starts 45-50 days after transplanting and lasts between 60 and 120 days.

Sheet 12 TECHNICAL ITINERARY FOR HERBS AND RED RADISH IN A GREENHOUSE

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

The overall cycle lasts 30 to 60 days, with the average being 50-60 days.
The basil cycle lasts 70 days as it needs more heat.

Prepare the soil for sowing directly:

After a tomato crop or a cucumber crop, mix the soil well so as to have a thin crumbly soil for the sowing to start well.
There is no need to bring more compost at the sowing time.

Sowing

The sowing depth is 0,5 cm. On a 1 meter line, you can sow up to 22 seeds, with 10 cm between the lines. The soil temperature should be 12°C minimum.

Sowing can be done by broadcasting or placing the seeds in lines along the rows. You can cover the seeds with a plastic sheet to keep humidity but be careful not to warm them too much during the germination process.

Keep conditions humid by watering regularly every day, but not too much.

Sheet 13 TECHNICAL ITINERARY FOR GREEN RADISHES IN A GREENHOUSE

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

GREEN RADISH

Total duration of the cycle

If you want the harvest to be at the beginning of October you should begin sowing in mid August. In general, the harvest will happen 100 to 110 days after sowing.

The final harvest will be in November. Then storage is possible in the cellar.

Sowing

The density for sowing is 15 cm on the rows and 40 cm between rows.

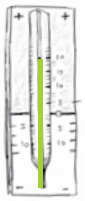
Water generously and regularly (do not let it dry).

No fertilization is required.

Sheet 14 TECHNICAL ITINERARY FOR BELL PEPPERS IN A GREENHOUSE

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

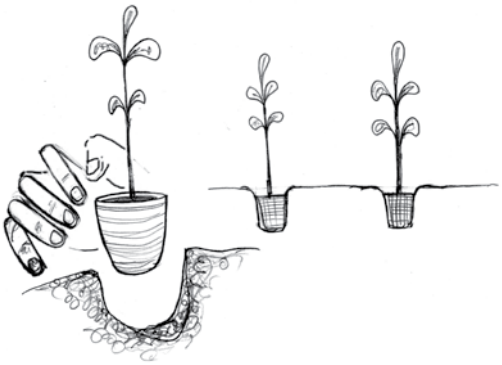
The overall cycle is 90 to 130 days:
- The cycle for green bell peppers is 90 days.
- The cycle for yellow or red bell peppers is 130 days. .



Germination happens 8 to 10 days after sowing

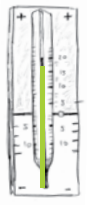
The day temperature should be kept at 23-25°C and the night temperature should be kept at 18-20°C.

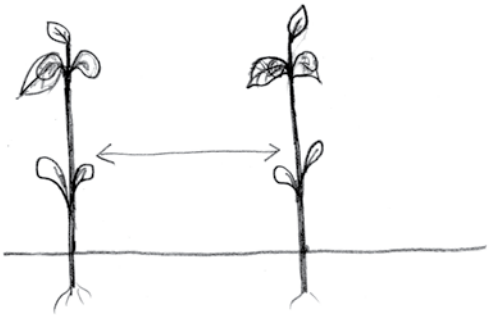
The first transplanting, into a cup, happens when there is one leaf, 15 to 20 days after sowing.



The second transplanting, into the ground, should happen 45 - 60 days after sowing, or when there are 5 leaves on the plant.

The soil temperature should be kept at 16-18°C.





Density of plants: In a row of 70cm width, the belt peppers should be planted every 40cm.

If the cup is biodegradable, it is also possible to sow seeds into the cups and then to transplant the cups directly into the ground after 40 days, after which point there should be 3 leaves.

Do not cover the collar

Put the plant in the ground up to the top level of the roots.

Preparation for transplanting:

Spread compost on the surface at a density of 7kg/ row.

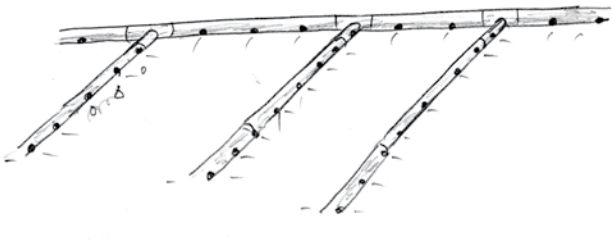
Mix compost with the earth to a level of 10cm.

When the flowers start to blossom, mix compost into the earth again, at the proportion 7 kg/row. Rake it into the surface to incorporate the compost elements in the soil.

Irrigation:

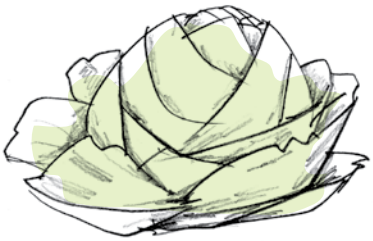
Install the drip irrigation system 10 cm away from the base of the plant.

It is possible to make a furrow to avoid directly watering the roots.



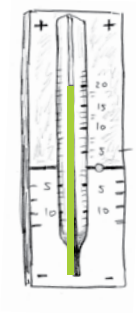
Bell peppers keep very well in the cellar.

Sheet 15 TECHNICAL ITINERARY FOR SPRING CABBAGES IN A GREENHOUSE



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

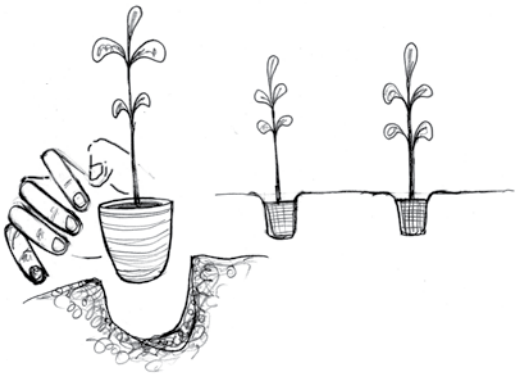
SPRING CABBAGE



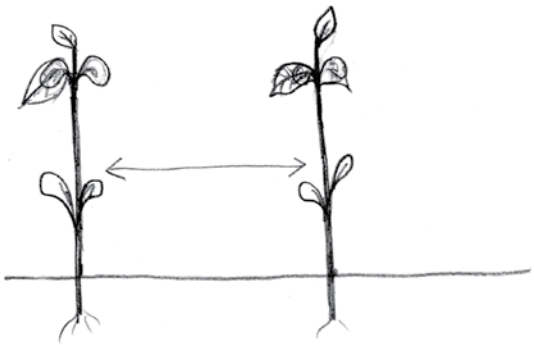
Sowing

The sowing temperature should be 23-25°C, with a minimum of 12°C. Transplanting is possible even when there are low temperatures.

Sowing should happen in the end of January.
It can be done in a small tunnel greenhouse, or in a box or in cups, which is the best option because the cabbages will grow faster under these conditions.



After 40-45 days, the spring cabbage is ready for transplanting.



Density = in a row 70cm wide, the plants should be positioned every 50cm.

60 to 65 days after transplanting, it is ready for harvest if the temperature is about average.
Green cabbage can be kept alive under temperatures from -6°C to 30°C.

It is possible to make a furrow that rises up to the bottom of the leaves.

Irrigation

Water well.
It is possible to water the leaves.
Water in the evening.

Sheet 16 TECHNICAL ITINERARY FOR GREEN MANURE INSIDE A GREENHOUSE

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

Green manure is grown inside a greenhouse and then incorporated in the soil.

Green manure is used to for the following:
- to increase soil fertility.
- to increase the humidity of the soil.
- to increase the nitrogen reserves in the soil if the green manure is a pulse.

During summer, inside the greenhouse, it is best to sow a green manure crop such as sorghum.
It is also possible to use mung beans or clover.

Sow at the end of June or the beginning of July.

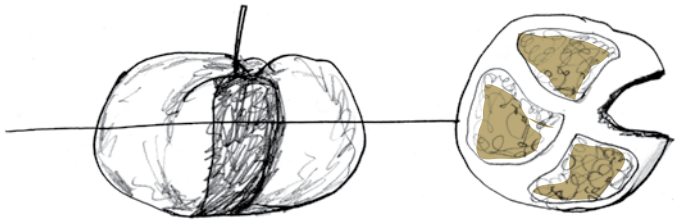
The sowing density is 0,5 kg/are.
Sow and water the soil.

For sorghum:

Cut when it grows higher than 15 to 20 cm. Leave the cuttings on the soil to compost.
15 days before sowing or transplanting a new crop, make a new set of cuttings and mix them into the first 10 to 15 cm of soil in the greenhouse.
Water the soil again.

Wait for 15 days and prepare the soil as usual for the next crop.

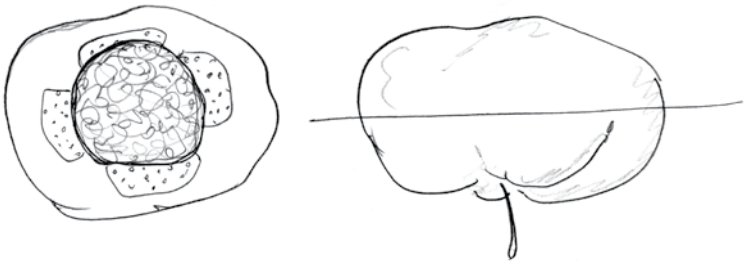
Sheet 17 PHYSIOLOGICAL DISORDERS – NECROSIS AND ROTTEN FRUIT ON TOMATOES



Symptoms: necrosis of one part of the tomato

Causes:
It is due to a problem of poor pollination in the greenhouse during winter.
In winter, pollination cannot happen for a number of reasons: The temperature is too cold, there is no wind and there are no insects who can pollinate the plants.

Solution: shake the flower stem and use a brush on each flower to disperse the pollen in the greenhouse.



Symptom: rotten fruit

Red fruits but black inside, soft to the touch.

Solution: remove the fruit and throw it away.

Sheet 18 PHYSIOLOGICAL DISORDERS - BLOSSOM END ROT AND FRUIT FLESH CRACKING

Blossom end rot

Symptom: black end rot, small black stain at the base of the fruit that goes up, little by little.

Cause: too much water asphyxiates the roots during certain periods, not enough water was dispensed at other times.

Solution: water in small quantities more often.

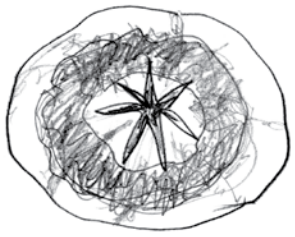
Fruit flesh cracking

Symptom: the flesh of the fruit develops cracks.

Cause: problem with irrigation.
The tomato plant was thirsty. When it is watered, it becomes saturated with water and the fruit bursts.

Solution:
Water regularly and check the water temperature, which must be at least at the soil temperature. Water early in the morning.

Sheet 19 PHYSIOLOGICAL DISORDERS: GREEN HALO ON TOMATOES AND PHYSIOLOGICAL LEAFROLL



Green halo

Symptom: a green halo of tough texture on the fruit.

Cause: - direct sun associated with high temperature
- Lack of potassium

Solution:
- Leave the plant in the shade.
- Leave the leaves that are above the fruits to protect them from the sun.
- Consider using another variety or find a more adapted variety that is more sun resistant.

Ensure a good intake of potassium.

Leafroll

Symptom: the leaf curls in on itself.

Cause: high temperature and low humidity.
To avoid losing too much water by evaporation, the plant closes its leaf spores and stops breathing.
In this manner, the plant blocks its own growth.

Solution: find another variety to use because the one in use is not adapted to the climatic conditions.
If leafroll only occurs for 4 to 5 hours per day, at the warmest time of the day, it does not pose a problem for the plant's development.

Sheet 20

PESTS | WINTER MOTH, CUTWORM, BRIGHT-LINE BROWN-EYE

Winter Moth

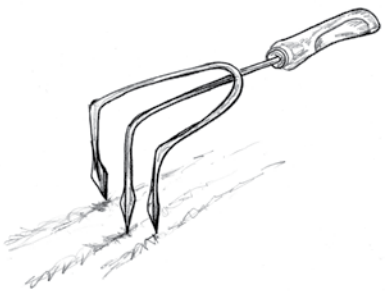
Damage: Eats around the collar and the roots.

Cutworm

Damage: Attacks the roots.

Bright-line Brown-eye

Damage: Attacks the fruits, leaves, stems.



How to fight these pests:

Work the soil: rake it to disrupt the caterpillar cycle
Trap the butterflies with pheromone traps
Release auxiliary insects to fight the pests
It is possible to fight against it by using bacillus thuringiensis.

Sheet 21 PEST| LEAF MINER

Damage: digs into the surface of the leaf.

How to fight against it:

Release auxiliary insects: small wasp, praying mantis, ladybug (beetle), green lacewing.

Sheet 22 PEST| WIREWORM

Damage: It attacks the roots by eating them all the way up to the collar of the plant.

How to fight it:

Rake the soil several times so that birds eat them before transplanting, at least 2 or 3 times with intervals in between.

When transplanting, it is possible to dip the roots of tomatoes and cucumbers seedlings in a powder preparation of dendrobacillin.

Sheet 23 PEST | APHIDS AND WHITEFLIES: THE SUCKING INSECTS

Aphids

Damage: the leaves shrivel, and honeydew appears on the leaves.

Whiteflies

They are little white flies that sting the bottom side of the leaves.
Damage: the leaves shrivel.

They are the main transmitters of disease, such as cucumber mosaic virus and other viruses.

How to fight:

1: If infestation is small, with black soap.
Mix 1 spoonfull of black soap for every 1 liter of lukewarm water.
Spray the plants in the evening after sunset but before dark.

2: If using black soap does not help, release auxiliaries.

3: If the infestation is big, prepare the following mixture:
Mix 1kg of ashes (wood, grass, but not coal) for every 8 liters of boiled water. Let the mixture sit covered for two days.
Filter the mixture to yield clear water. Add 40g of black soap to the water and spray on the plants.

Sheet 24 SOIL DISEASES, ALSO CALLED WEAKNESS DISEASES

They are fungi that develop on the roots.

Black root rot

Symptom:
The stem becomes black at the soil level and the plant falls.
When the plant is taken out of the soil, the root is black and rotten, and the plant had been developing slowly.

Cause: It can be caused by a problem during transplanting. For example, watering was too generous, roots have been asphyxiated then the fungi comes and settles down.

Solution
During transplanting, don't water the plants excessively.

Anthracnose and Phytophtorose

Symptom:
Unhealthy looking plant, slow growth, and discolored leaves.

Fusariose = bacterial fire

Symptom: the plant wilts and dries on the spot over a one week period (be careful not to confuse it with the plant getting cold, which exhibits the same symptoms but over a one or two day period).

HOW CAN THESE DIESEASES BE PREVENTED?

Be careful to rotate your crops on the plot to avoid putting together the same vegetable family.
Prophylaxia= disinfect the seeds with potassium permanganate, which can be found at the pharmacy in powder form.
1 g = 2 somonis.
Preparation: use 2g for every 10 liters. Put the seed in the preparation for 20 to 30 minutes, and then let it dry for 6 hours before sowing.

HOW TO TREAT THE DISEASES?

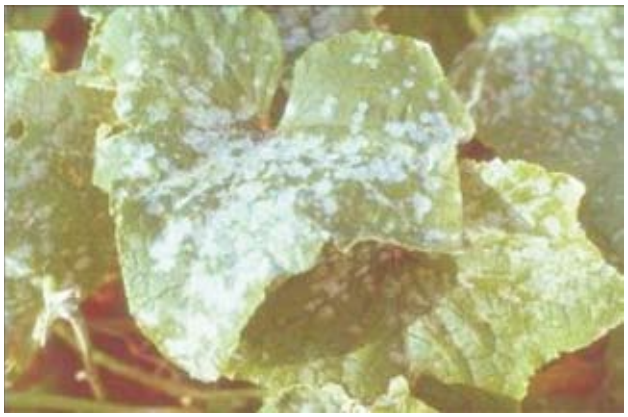
Remove the plant and the soil around.
Burn the rest of the crops.
If the contamination is substantial (more than 50% of the total area), then the soil should be disinfected through solarisation. If this is not possible, avoid planting the same family of vegetables in that plot for 7 years.

Sheet 25 DISEASE: OIDIUM AND MILDEW

Mildew

Symptoms:

The leaves get dark and dry but don't fall off. The disease starts from the bottom of the plant and works its way up. The fruits develop a brown marbled-looking skin.



Oïdium

Symptoms:

White mold on the bottom side of the leaves.
On the top side, the leaf is yellow.

The strains of the fungi of mildew are different for cucumbers and tomatoes but the symptoms are the same, although they cannot be transmitted from one to the other.

In both cases, it is a problem of humidity in the air and of the temperature.
The propagator is wind.

To prevent mildew:

Be careful to ventilate the greenhouse correctly and not to sow too densely.

To treat

The treatment to fight against mildew and oidium:
Prepare a solution of 10g of sodium bicarbonate or potassium bicarbonate for every liter of water to spray on the sick leaves and fruits.

It is possible to use sulfur before the fruits reach maturity.

Sheet 26 DISEASES | TOBACCO MOSAIC VIRUS

Symptom:
Small patches of the leaves change color.
The plant dries slowly.

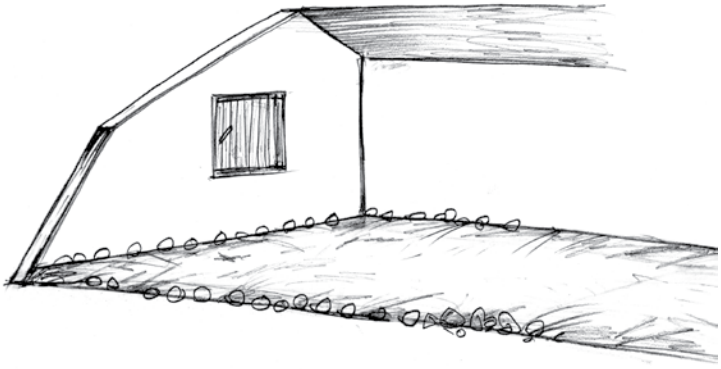
Cause:
The virus is transmitted by the bites of aphids and white flies.
It appears on old plants. It is a weakness virus. It is very contagious from the old plants to the young ones.

Solution:
Avoid infestation of insects, such as aphids and whiteflies.

Sheet 27 SOLARIZATION TO DISINFECT THE SOIL

In case of severe disease of the soil, solarization of the soil is better than the withdrawal of all the soil.

What is solarization?
It is in an increase of the soil temperature higher than 80°C, which destroys the different disease agents (fungi, bacteria, pest) and weeds.



Implementation:
During the summer :
- Prepare the soil as if you were going to sow it.
- Water the soil generously.
- Place a transparent tarpaulin without holes directly on the soil surface immediately after watering.
- Cover the sides of the tarpaulin with soil to seal it hermetically.
- Do not walk on the covered tarpaulin.
- Close the greenhouse and the ventilation windows to increase the temperature.
- Leave the tarpaulin for 3 weeks if the greenhouse is covered with polyethylene or 1,5 months if the greenhouse is not covered.

For the next crop, sow without working the soil too deeply (maximum 10cm).

Thanks to this technique, the soil fertility is preserved, which is not the case when all the soil is replaced.

Sheet 28 CLIMATIC MANAGEMENT OF THE GREENHOUSE

Setting up and taking down the polyethene

So as to ensure good crop conditions for the plants, it is necessary to take out the polyethene in the spring and to put it back in the fall.

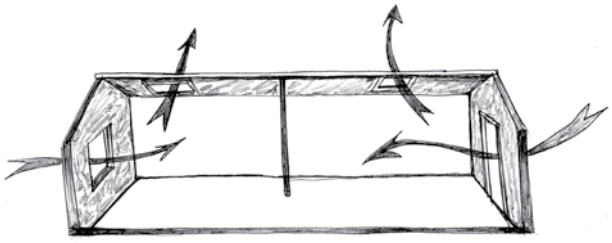
The timing for setting up and taking down the polyethene differs depending on whether the greenhouse is in the plains or the mountains.

IN PLAINS: (between 0 and 800m elevation)
Mid October: close the greenhouse (according to the weather) if the night temperature is below 12°C.
Mid April: open the greenhouse if the day temperature is above 30°C and the night temperature above 12°C.

MOUNTAIN (above 800m elevation)
mid-September: cover the greenhouse (when the night temperature is below 12°).
mid May : open when the night temperature is above 15°C.

VENTILATION of the greenhouse

- Keep an eye on the minimum and maximum temperatures both inside the greenhouse and outside.
- Ventilate according to the following table.



	day				night		
Inside minimum temperature	>20	15<T°<20	>12	<12	>15	>15	<15
Outside maximum temperature	>20	15<T°<20	<12	<12	>15	<15	<15
What to open?	Roof opening, door, window	Roof opening completely open	Roof opening half open	Roof opening a little open	Roof opening, door, window	closed	closed

- Check the humidity.
If the humidity goes below 80%, water the soil surface.

Sheet 29 GREENHOUSE MANAGEMENT: SETTING UP THE POLYETHYLENE

It is not helpful to put a double layer of polyethylene for vegetable growing (tomato, cucumber) because you lose light even though there is a heat gain. Nevertheless, it can be useful for growing herbs.

Order of installation:

- set it up on top, set it up at the bottom, then on the sides.

On the greenhouse sides:

Put a lot of dirt or rocks (so that it weighs heavily).
Or roll it around a wooden latter to nail to the wall.

Install it at the bottom:

- Dig a hole if possible, put the polyethene in it and cover with soil.

Or

- Roll it around a wooden beam and nail everything.

To prevent the wind from disrupting it:

Put strings or straps from the top of the greenhouse and tighten them at the bottom with weights or by setting up stakes in the wall.
Put the strings or straps along the beams to limit shadowing.

To maximize the use of polyethylene:

- Paint the wireframe with a rust proofing agent or oil it.

To take away the polyethylene and store it:

- Roll it to fold it on the top while making sure that the last fold is made towards the inside of the greenhouse (to avoid accumulation of water).
- Fold it as small as possible to protect the tarpaulin from the sun.

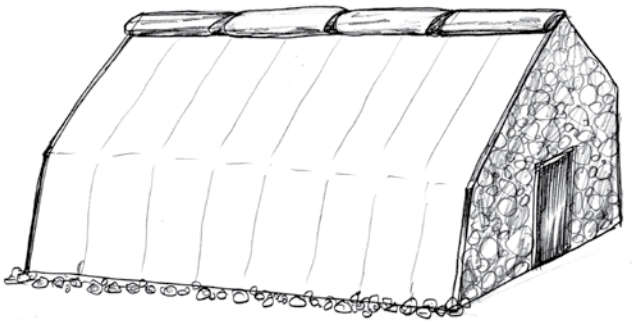
Sheet 30 CLIMATIC MANAGEMENT OF THE GREENHOUSE: NIGHT COVER

The night cover avoids losing the heat gained during the day in the greenhouse. With only a polyethene cover, 70% of the greenhouse heat will escape at night.

Installation

Set up the blankets on the outside, at the top of the greenhouse, next to one another.
Unroll them on the tarpaulin.
Make sure that they cover all the polyethylene area.

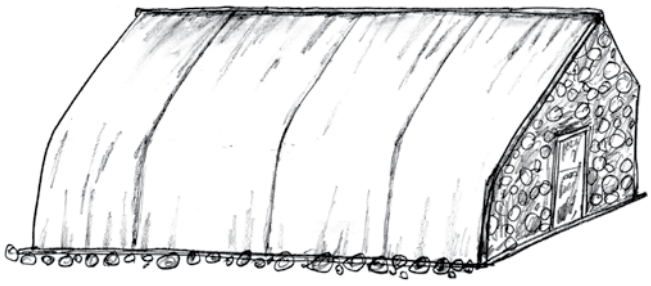
There are different ways to roll up and unroll the night cover:
- Attach two strings to the bottom of the night cover to pull it up and down.
- Roll it around a long wooden or metal strip.



How to use it:

In the morning, when there is already sunshine on the greenhouse, roll up the night cover and set it tightly so that the wind blowing won't move it.

In the evening, about 15 minutes before there is no more sunshine on the greenhouse, roll down the night cover to cover the entire greenhouse.

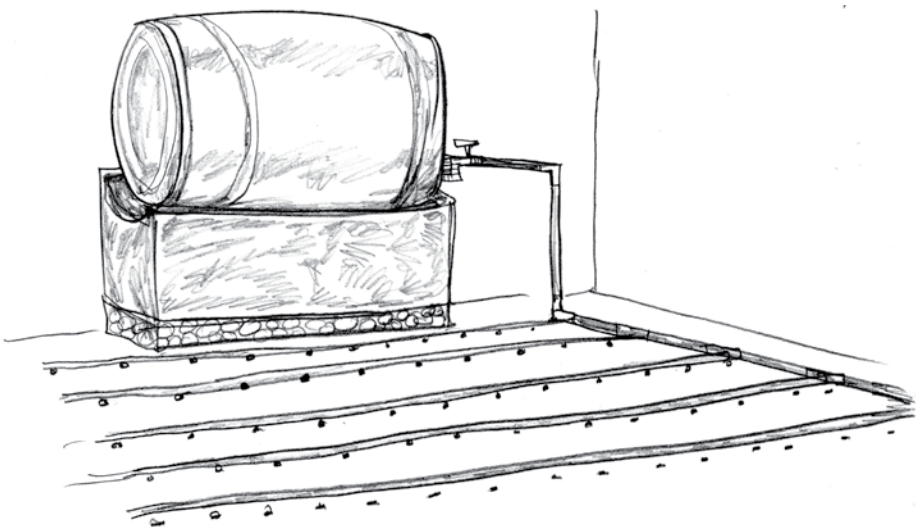


In the winter, or during a day without sun, you should roll up the night cover for at least 4 hours between 11am and 3pm to find a balance between the need for light for the plants and heat loss.

Sheet 31 SETTING UP A DRIP IRRIGATION SYSTEM

Drip irrigation is very well adapted to greenhouse crops that need small quantities of water on a regular basis. This method is efficient because it avoids losing water through evaporation.

During the winter, it is advised to use water which will be at the same temperature as the soil. The water tank is located inside the greenhouse, and as a result it has the same temperature as the soil. This method prevents thermal shocks at the root level.



Put the water tank 1m to 1.5m above the ground to insure constant water pressure.
Connect the water tank with a main pipe and a tap.
Bring this pipe to the beginning of the crop rows.
Add the diversions in front of each row and connect the main pipe with the secondary pipe that will have holes or dripper lines.

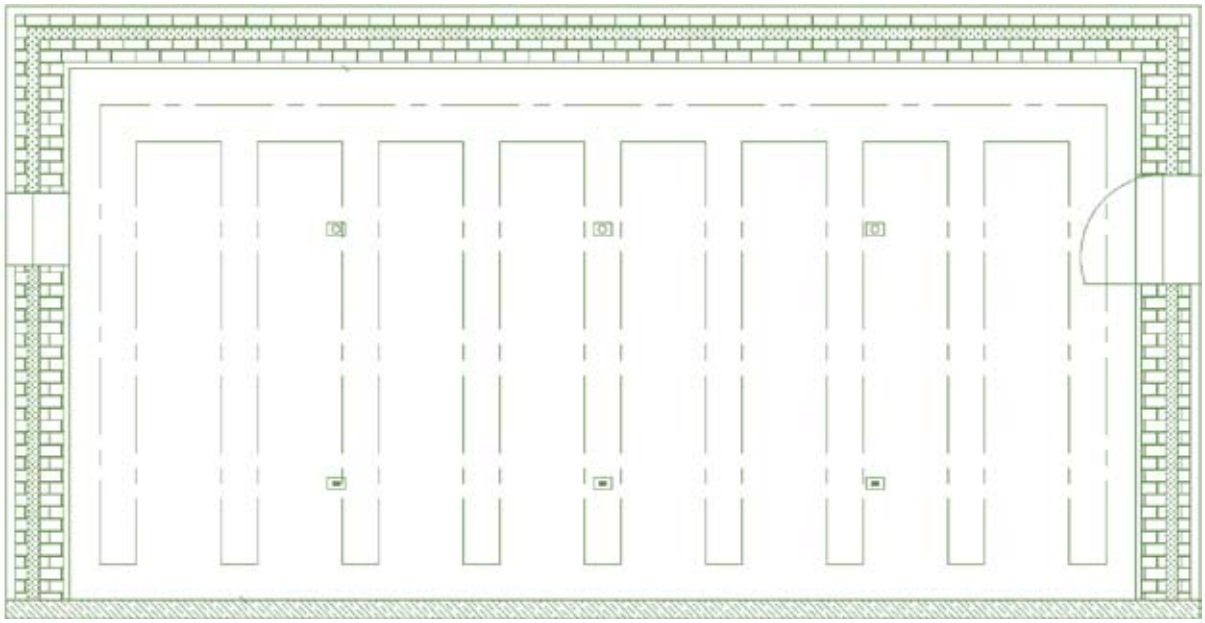
You should set up an independent system of watering for different crop types with different watering needs. For example, you can install a pipe that waters only the cucumbers and another one only for tomatoes.

You should be present during the irrigation to oversee the quantity of water given to each crop and to make sure that the drippers work well.

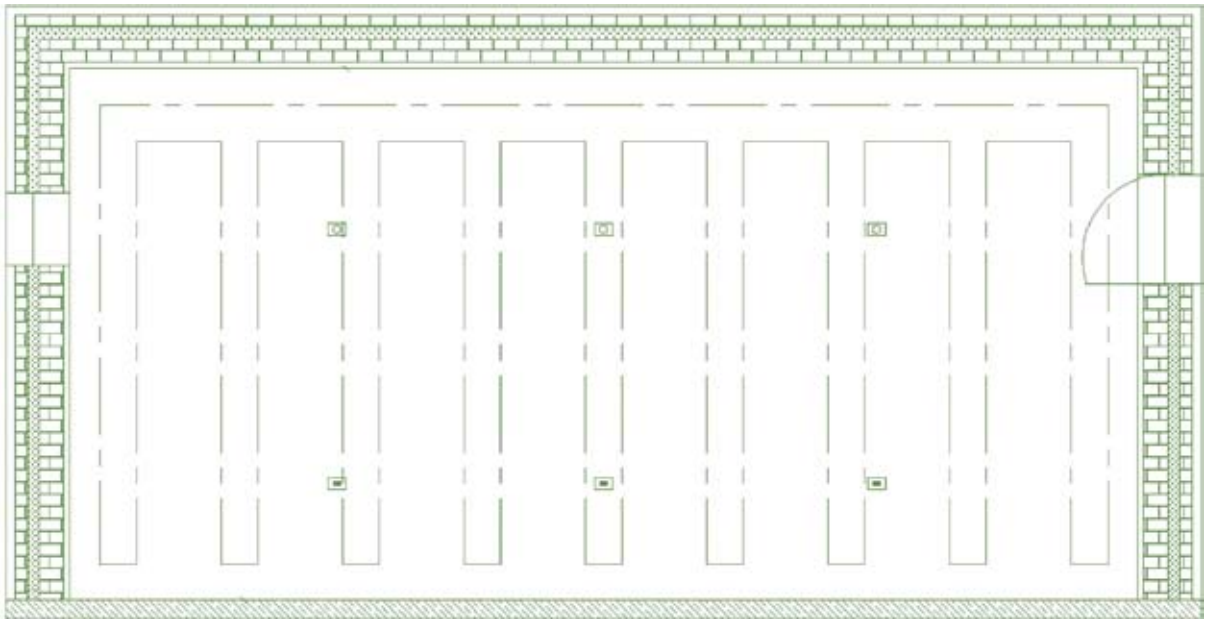
Water needs increase with temperature:
In the winter, irrigation can happen once a week.
In the summer, every other day.

Sheet 32 GREENHOUSE RECOMMENDED LAYOUT

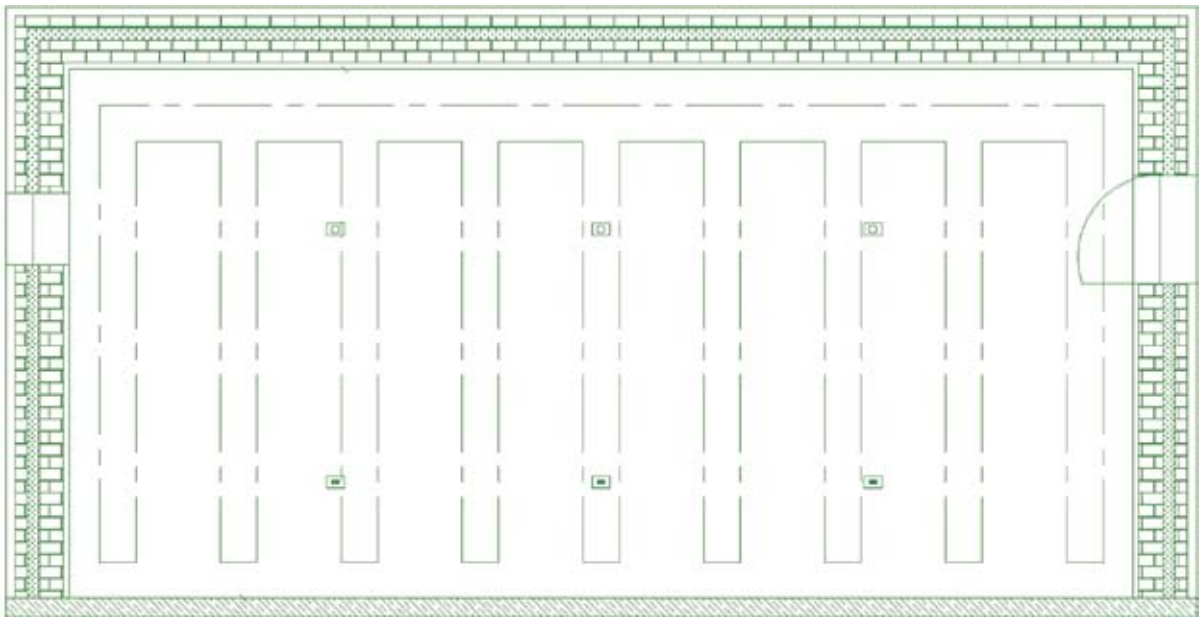
Fall crop



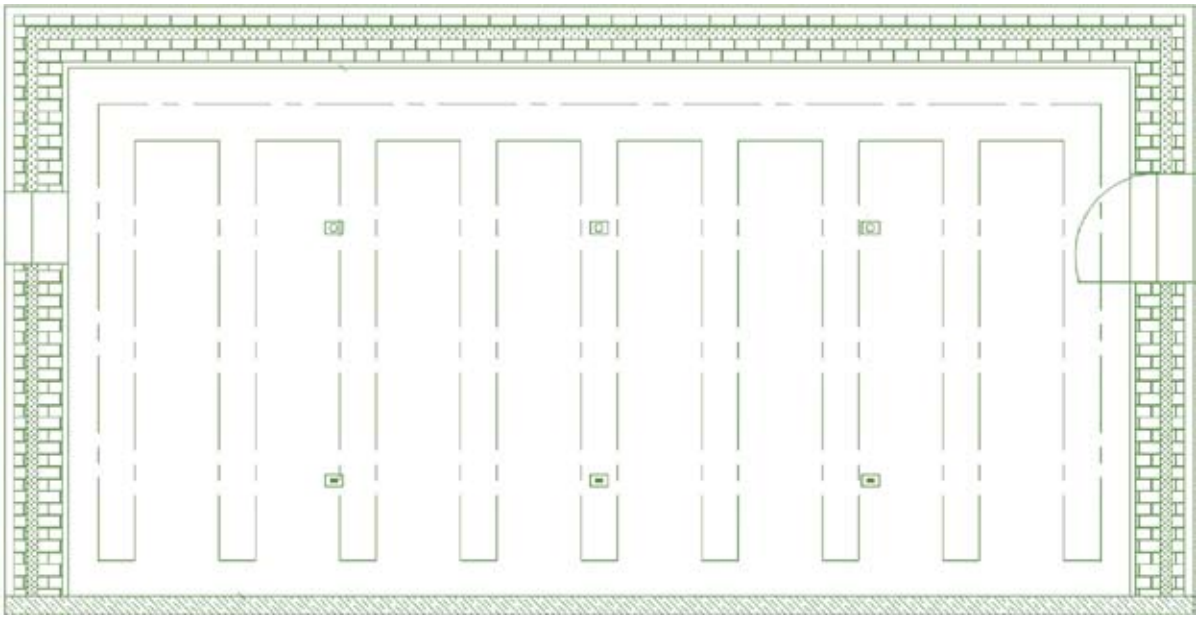
Winter crop



Spring crop



Summer crop



Sheet 33 POLYETHYLENE, SEEDS SUPPLIERS, DRIP IRRIGATION

These people can order good quality polyethylene and seeds and have them available in their shops for you.

Don't hesitate to call them:

In Fon Dario Jamoat (Ayni district)

Kosimov Shodimurod
927575133
902403845
Sarvoda Bazaar, Store «Farzona»

In Oshoba Jamoat (Asht district)

Iuldoshev Sherzod
928098087
High Appon

NOTES

GERES - TAJIKISTAN
Address: Republic of Tajikistan, Dushanbe, Khamza khakimzoda Str. 79
Phone: (+992) 37 880 65 64
E-mail: tajikistan@geres.eu
Web: www.geres.eu

ASDP - AGENCY FOR SUPPORTING OF DEVELOPMENT PROCESSES
Address: Republic of Tajikistan, Khujand, Lenin Str. 20-34
Phone: (+992 34) 224-53-20; 6-03-62
E-mail: office@agencynau.tj
Web: www.agencynau.tj