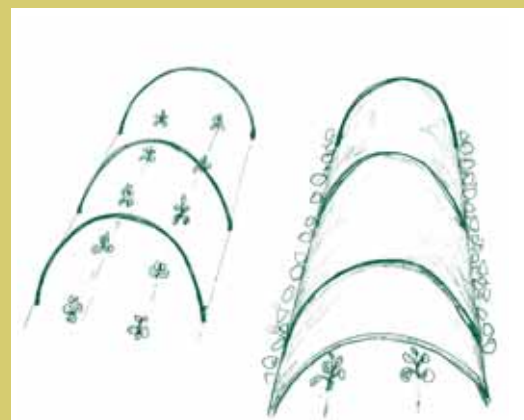




Growing vegetables in an open field in Tajikistan

An agro-ecological guide for farmers



Growing vegetables in an open field

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Netherlands



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2013





FOREWORD

In 2011, ASDP Nau and GERES launched a project to help small scale farmers increase their agricultural income 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 150 farmers by training them in techniques to improve agricultural productivity in an open field.

This brochure gives guidelines on how to improve crop rotation, how to avoid erosion and loss of nutrients in the soil by using winter cover, how to make compost and increase soil fertility as well as a few tips on how to recognize pests and fight them. The overall aim is to give tools to farmers that can help them sustain their businesses.

The advice provided in this publication 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).

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Sheet 1

CHOOSING WHICH CROPS TO GROW IN AN OPEN FIELD

The choice of crops will be made according to the following factors:

- crop rotation: you should look at where the crops were situated the previous year to avoid growing the same crops in the same place
- the opportunity to sell the leftover harvest after the household has fed itself.

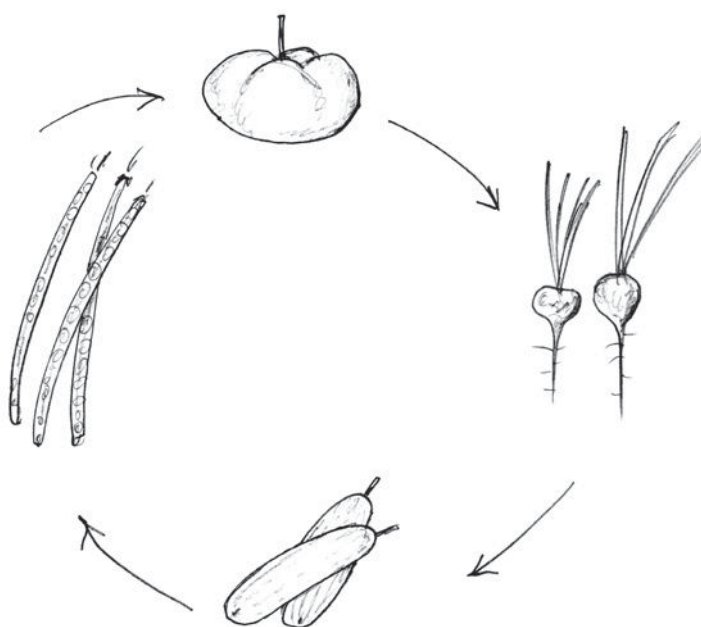
Principles of crop rotation

Crop rotation has 3 goals:

- increase yield
- get rid of pests
- get rid of weeds

The principles of crop rotation include the following rules:

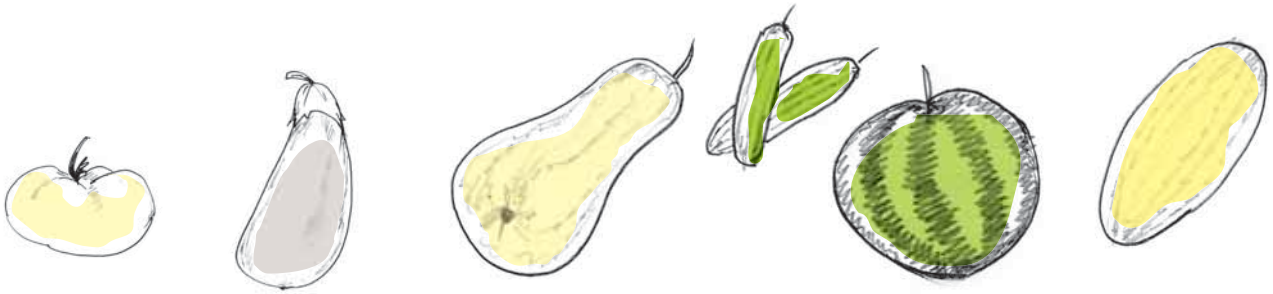
1. Make sure that 2 vegetables of the same family don't follow each other,
2. Look at the part of the vegetable that is harvested: don't grow two root vegetables or two fruit vegetables after one other,
3. Avoid growing 2 families of vegetables that have high fertilization needs one after the other.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



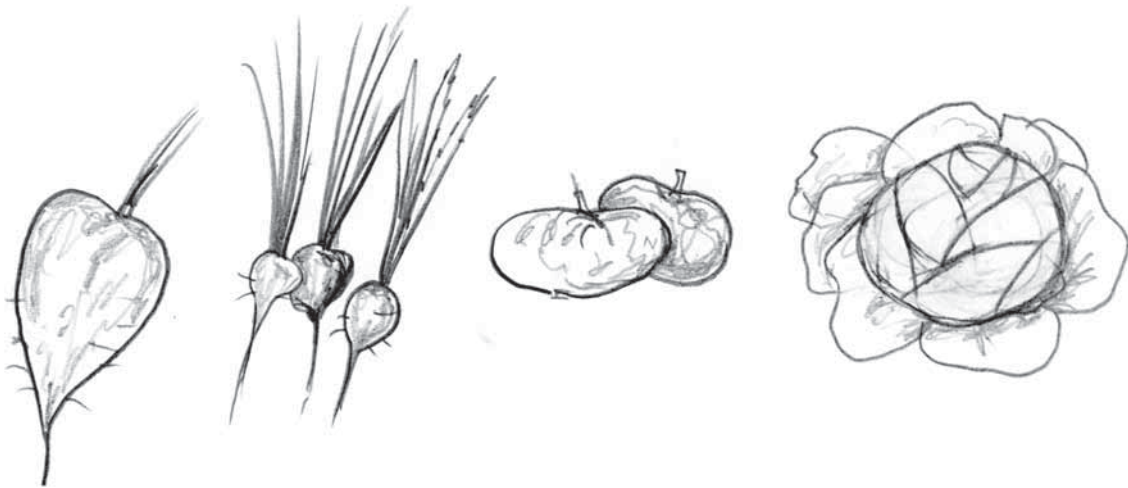
Solanaceae: tomato, belt pepper, chili pepper, potato, eggplant.



Cucurbitaceae: cucumber, pumpkin, watermelon, melon.



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

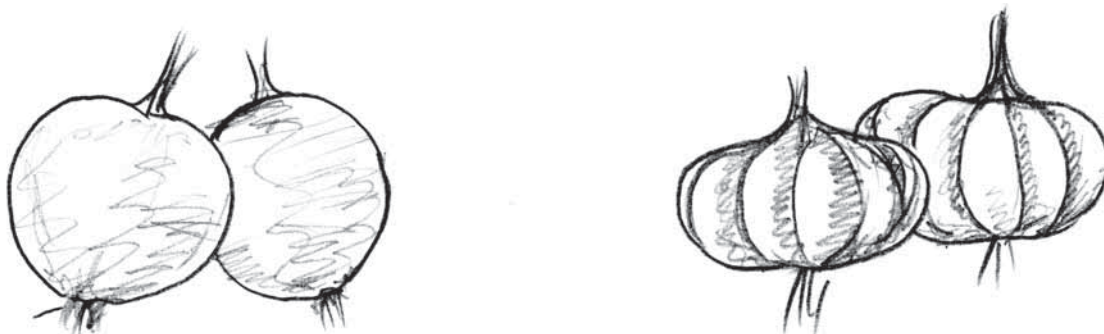


Chenopodiaceae: beet, spinach.



Apiaceae: carrot.

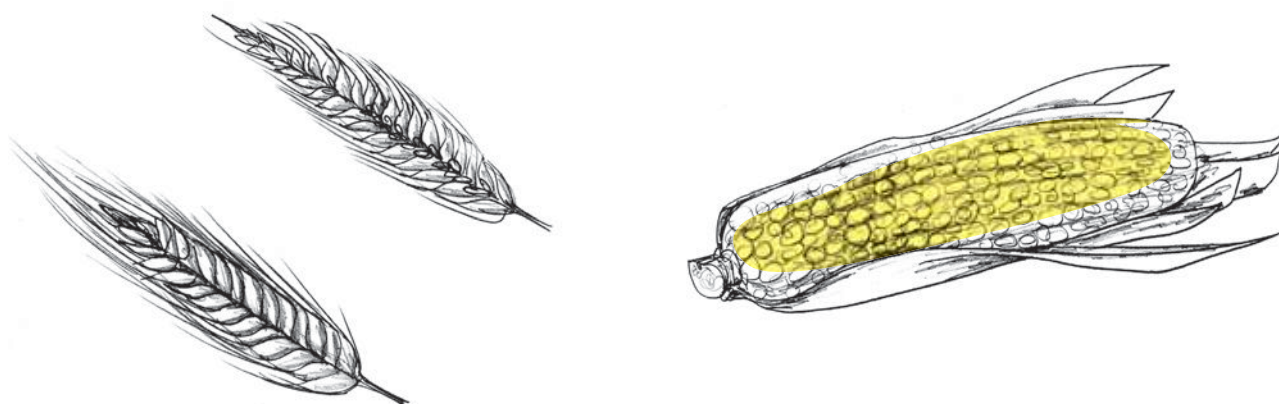
Amaryllidaceae: onion, garlic.



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



Poaceae: wheat, barley, maize





Prices of vegetables during the year

The prices of the vegetables during the year should also influence your crop rotation plan.

If you consider selling vegetables, you should try to adjust your sowing time so as to be able to harvest when the prices are still high.

To be able to sell the vegetables for a good price, it is possible to advance the harvest time by:

- producing your own seedlings (see sheet production and transplanting of seedlings)
- using tunnel greenhouses (see sheet on how to make a tunnel greenhouse)

Sheet 2

DESIGNING A PLAN FOR YOUR CROPS

3 principles should be followed to design a plan for your crops:

- respect the principle of crop rotation
- check that climatic conditions are favorable for the crop you choose (warm enough)
- check that the crop brings some financial value

Example of crop planning for a low elevation area (400m, possible to do 2 harvests a year)
The plot is divided into 6 parts for which a different crop will be grown.

	1	2	3	4	5	6
Year 1						
First crop	tomato	cabbage	carrot	cucumber	eggplant/sweet pepper	barley
Second crop	green radish	carrot	wheat	cabbage/maize		onion
Year 2						
First crop	cucumber	tomato	melon	eggplant/sweet pepper	spring cabbage	onion
Second crop	wheat	Green radish	onion		bean	cabbage
year 3						
First crop	carrot	cucumber	onion	barley	melon	tomato
Second crop	garlic	sorgho (green manure)	cabbage	red beet	wheat	bean

Example of crop planning for a high elevation area (1500m)

The plot is divided into 6 parts for which a different crop will be grown.

1	2	3	4	5	6
Year 1					
tomato	Tomato	carrot	cucumber + bean	cabbage/ green radish/ red beet	barley/wheat
Year 2					
cabbage/ green radish/ red beet	Barley/wheat	tomato	tomato	carrot	cucumber + bean
year 3					
carrot	cucumber + bean	cabbage/ green radish/ red beet	barley/wheat	tomato	tomato

For small mountain plots where potatoes cover most of the field every year, try and rotate the vegetables that are not potatoes every year on a different place.

For potato growing:

before sowing, manure (1 to 2 year old manure) should be added in a quantity of up to 20-30 t for 1 ha.

A possible crop rotation with potatoes is:

Year 1	Year 2
potato	wheat
Potato	cabbage/ broad bean
potato	barley
potato	carrot

If you do a rotation with beans, it is possible after having grown beans to sow a crop that needs a lot of fertilization, since thanks to the effect of beans on the soil, you will need to add only a little bit of compost before sowing.

Sheet 3

CHOOSING YOUR SEEDS

Try and buy seeds that are clearly identified (name, origin, expiration date).

Thoroughly familiarize yourself with the following information:

- name of the variety:

Write it down on your agricultural plan to remember it. If the plant gives good results, you can plant it again, and if it does 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

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.

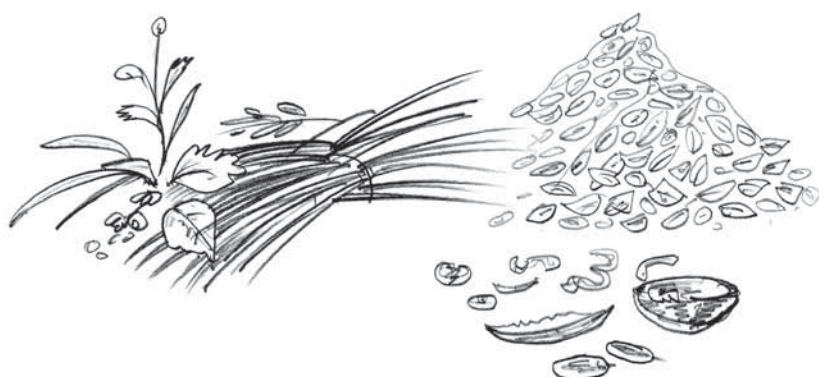
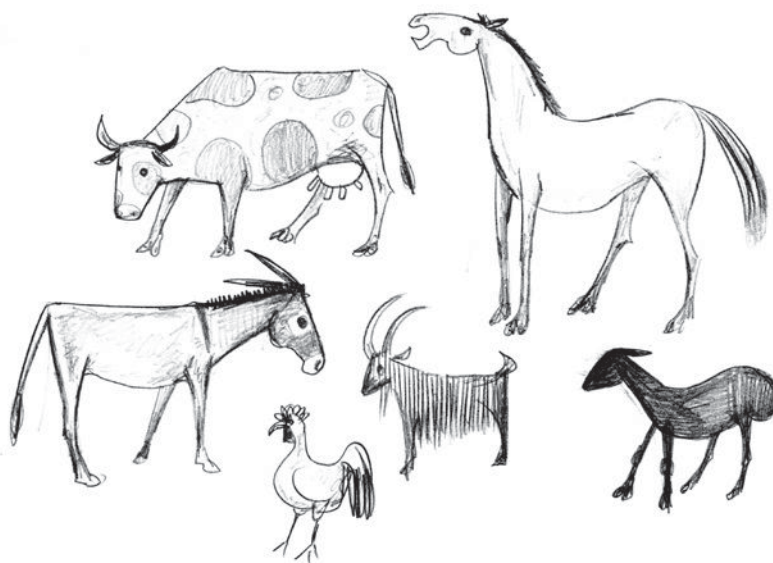
To make compost :

Dig a pit :

depth 1 m, width 1m, length 1,5m

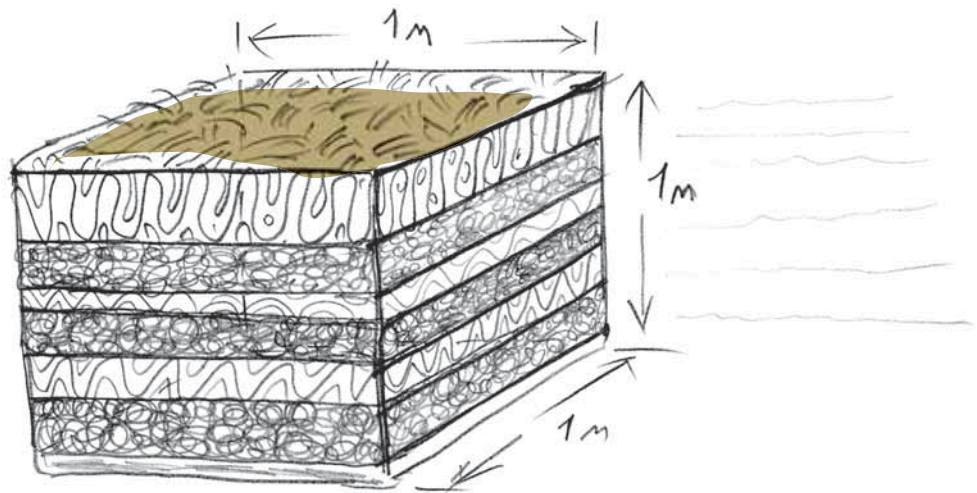
Use:

- 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 5

PREPARE THE SOIL FOR A CROP

If you prepare the soil during autumn, you can bring fresh manure that you spread on the surface of the soil and then mix with a hoe not too deeply.



During spring, work the soil on the surface only, and then sow and transplant.

If you prepare your soil during spring, spread very mature compost over the soil that will get mixed in during ploughing.

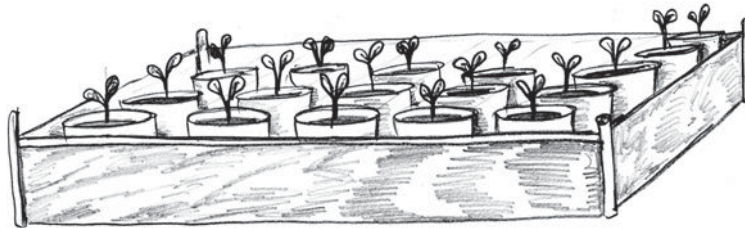
If you spread the compost in autumn, it will lose all its properties for the spring culture. The manure brought in autumn will start to decompose in the soil so as to release the fertilizing components little by little.

The quantity of compost should be 100 kg/are.

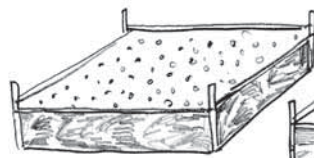
To prepare the soil for sowing: make the soil thin with a hoe or with the clod roller placed behind the plough.

Sheet 6

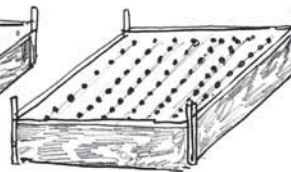
GROWING SEEDLINGS



Sowing:



BY SCATTERING



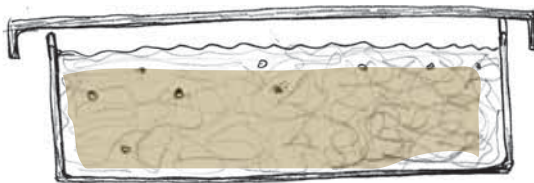
SOWING IN LINE



IN CUPS

(MADE WITH PAPER, CARTON,
RECYCLED PLASTIC CUPS)

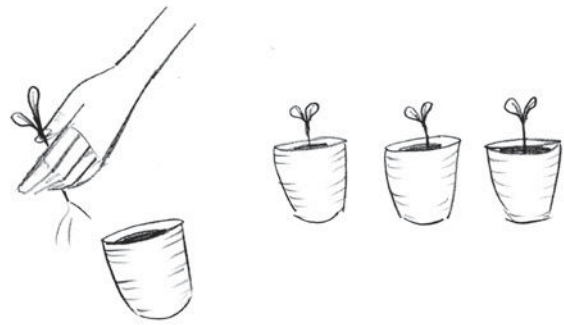
- In a box:
- Prepare the soil for the seedlings by mixing compost (70%) and soil (30%).
- Put this mix in a box.
- Fill up to 2 cm from the top of the box.
- Sow and cover with 0,5 cm of this soil and compost mix.



- 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

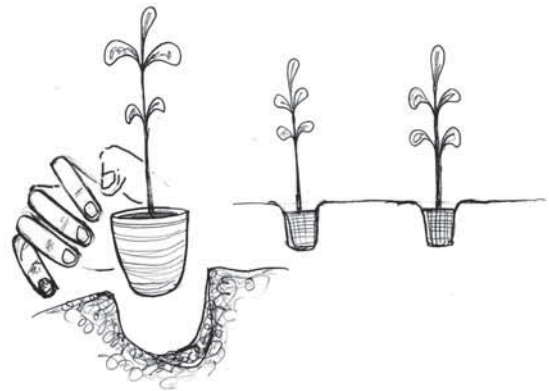


Avoid watering the box before transplanting.
Before transplanting, prepare the cups: fill them with the mix of compost and soil.
Then with a small spoon, make the soil crumbly to be able to take the plantlet without damaging its roots.

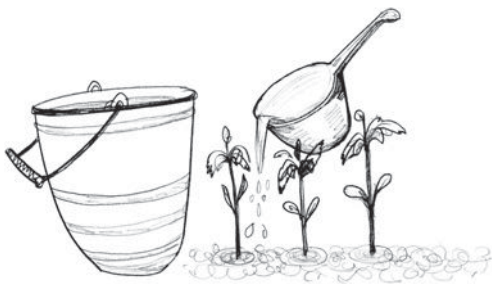
Make a first hole with your little finger.
Insert the plantlet carefully and squeeze the soil around it by compacting it.

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 7

GROWING CROPS UNDER TUNNEL GREENHOUSES

The tunnel greenhouse warms up the soil thanks to a polyethylene sheet placed on small wire hoops.

The tunnel greenhouse allows you to:

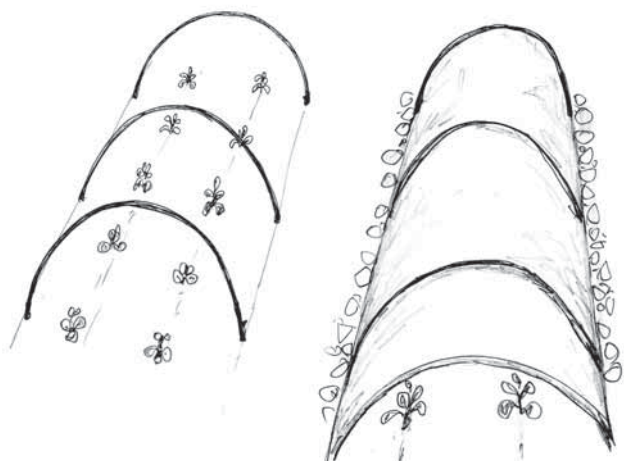
- prepare your plants in cups to transplant them afterwards,
- sow or transplanting 15 days in advance.

Needed equipment: polyethene sheet, wire hoops of 2m -2,5m (diameter <0,5cm).

Implementation

Prepare your soil by mixing soil and compost in a layer of 15 cm depth.

Sow or transplant in line,



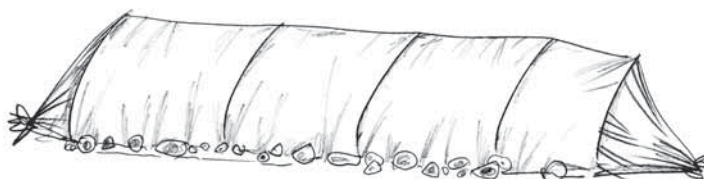
Set up the wire hoops every 2 meters apart at maximum,

Put the polyethylene sheet on top and hold down the sides and the ends with rocks, making sure the sheet is well tightened.

During the day if the temperature is too high, it is possible to open one side (or both) of the tunnel a little by propping it up with wood sticks.

Be careful to close the side when the sun sets.

Don't forget to water the crop sometimes. To water, take off all the polyethylene sheet on one side.



Sheet 8

WINTER GREEN MANURE

Green manure is a crop that will be destroyed on the spot in the field and that will be mixed into the soil directly.

The installation of the winter green manure allows you to keep the soil from being barren which provides these benefits:

- avoiding erosion,
- keeping nitrogen in the soil,
- loosening the soil.

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

Implementation

Prepare the soil to sow the chosen crop (green manure),
Sow in August or the beginning of September and let it grow.
But never let the cover crop grow to seed! Don't let them grow too much.

At the beginning of spring, before the starting of the growth of the vegetation, mix it in the soil by ploughing when you prepare the soil for the next crop.

Wait 15 days before sowing a new crop.

It might be necessary to work again the soil in surface.

Choices of crops to use

The poaceae (wheat, barley, oat, rye..) are good to ensure good crop rotation. These crops are also resistant to trampling.

Clover and pea are also good cover crops as they bring nitrogen in the soil.

Mustard is good for disinfecting the soil.

They should be sown under the vegetable that is already growing so as to grow enough before the winter rest.

Sheet 9

GOOD WATERING PRACTICES

Water during the cool part of the day:

In spring and fall, water in the early morning

In summer, water preferably in the evening

Don't irrigate during the hottest part of the day to avoid:

- water waste (more evaporation)
- disease problems (if too much humidity)
- burning of the leaves

Water should not be too hot, neither too cold

Do not use cold water directly from the river

Let it warm up in a water tank

Check the water with your hand before using it

Get the right irrigation practice

For young plants: add water very softly, no direct pouring

Use the sprinkler head of the watering can on short plants (lettuce, cabbage, radish)

Water gently at the plant's foot for large plants (tomato, pepper, cucumber, zucchini and cauliflower)

Bad irrigation practices: splashing the plants and overwatering

Flooding brings disease, creates root asphyxia, damages young plants and wastes water

Good irrigation practice

Using the sprinkler head thus creating a small rain on the plants

Irrigate with the right quantity at the right frequency

For every vegetable

- before and during the germination, the soil should be kept humid

=> every day, add a small quantity of water

- during the vegetative growth

=> longer deep soaks are better than frequent watering.

This will create more drought resistant plants

- during fruit formation: avoid shortage



Example for tomato

Tomato			
Initial stage	Vegetative growth	Flowering stage	Fruit stage
0,5 L / plant	1 L / plant	1,5 L / plant	3 L / plant
1,25 L / m ²	2,5 L / m ²	3, 75 L /m ²	7 L/m ²

Crop water needs		
Low	Medium	High
Onion Garlic	Beans Cabbage Lettuce Peas Radish Spinach	Broccoli Cauliflower Cucumber Eggplant Pepper Squash Tomato

Sheet 10

SETTING UP A DRIP IRRIGATION SYSTEM

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

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 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.

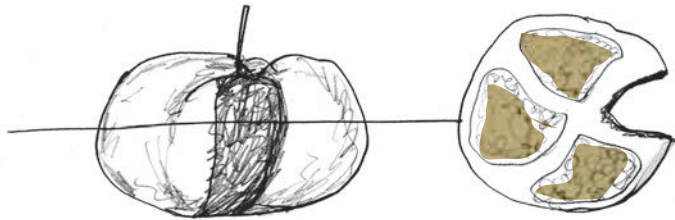
Water needs increase with temperature:

In the summer, irrigation should happen every other day.



Sheet 11

PHYSIOLOGICAL DISORDERS – NECROSIS AND ROTTEN FRUIT ON TOMATOES



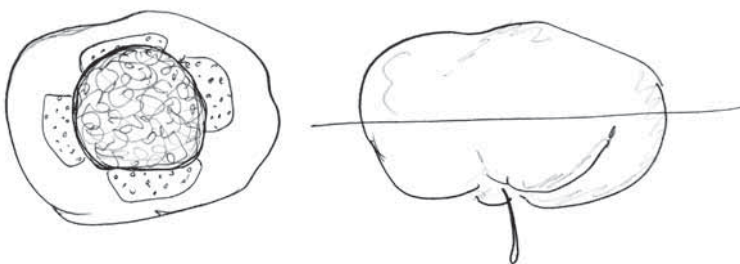
Symptoms: necrosis of one part of the tomato

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.



Symptom: rotten fruit

Red fruits but black inside, soft to the touch.

Solution: remove the fruit and throw it away.

Sheet 12

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.

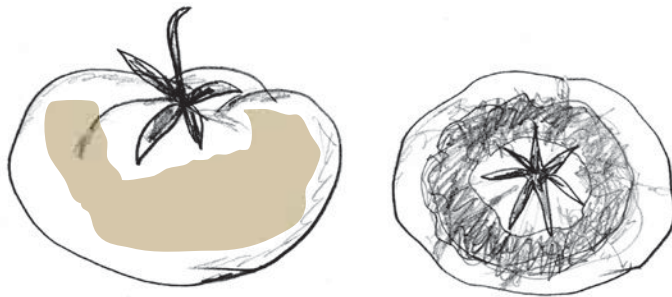
Solution:

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



Sheet 13

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 14

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



Winter Moth

Damage: Eats around the collar and the roots.

Cutworm

Damage: Attacks the roots.

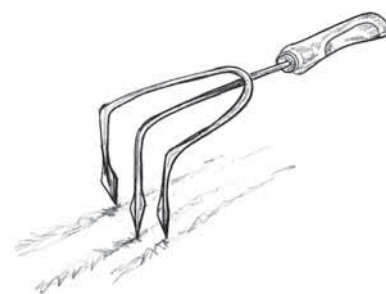


Bright-line Brown-eye

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 15

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 16

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 17

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 18

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 Phytophthora

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 DISEASES 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 19

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.



Oidium

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 20

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 21

SOLARIZATION TO DISINFECT THE SOIL

In case of severe disease of the soil, the farmer can try the solarization of the soil.

What is solarization?

It is 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 (you have to make sure to have 3 consecutive days of sunshine for this technique to work):

- 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.
- Leave the tarpaulin for a minimum of 5 weeks

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 22

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

[illegible]



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@agency nau.tj
Web: www.agency nau.tj