



Plant Propagation: Planning

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Program

- ▶ 1- Choose your greenhouse vegetable cultivars
- ▶ 2- Determine the quality criteria of the transplants
- ▶ 3- Define the densities
- ▶ 4- Determine the number of plants to produce
- ▶ 5- Determine the space needed in the nursery
- ▶ 6- Calendar and management of the nursery space
- ▶ 7- Nursery layout
- ▶ 8- Choice of substrates

Program (continued)

- ▶ 9- The choice of containers
- ▶ 10- Grafting equipment
- ▶ 11- Other equipment
- ▶ 12- Fertilization of transplants

1- Choose your greenhouse vegetable cultivars

- ▶ Desired qualities:
 - Market
 - Taste
 - Yield
- ▶ Disease resistance
 - Basic kit required

1- Choose your greenhouse vegetable cultivars: Tomato resistance

▶ Main soil diseases:

- PL corky roots rot (tomato)

➡ No graft is resistant = rootstock

- FOL: Fusarium wilt (tomato)
- FOR: Fusarium crown and root rot (tomato and cucumber)

➡ Resistance not always present = rootstock

- Va Verticilium albo-atrum
- Vd Verticilium dahliae

▶ Nematodes

1- Choose your greenhouse vegetable cultivars: Tomato resistance

Starter pack:

► **ToMV:0-2, Ff:AE, Fol:1,2, For**

- Tomato Mosaic Virus race 0 to 2
- Passalora fulva (Pf) race A to E (12 races in all) (formerly Fulvia fulva (Ff)) and Leaf Mold (LM), Cladosporium fulvum (Cf)
- Fusarium oxysporum f.sp. lycopersici (race 1 and 2)
- Fusarium oxysporum f.sp. radicis-lycopersici



leaf mold

1- Greenhouse tomato cultivars:

Preference small scale farmer	Type	Color	Cultivar	Seed company	Fruit size (g)	Leaf mold resistance	HR	IR
1	Beef	Orange	Beorange	De Ruiters/Bayer	200-220	Yes	Ff: 1-5/Fol: 1,2/For/ToMV: 0-2/NTMV: 0	
1	Beef	Pink	Pink ID	De Ruiters/Bayer	220-240	Yes	ToMV:0-2/ToANV/Ff:A-E/Va:1/Vd:1/Fol:0,1/For/Si/Ss/Sbl/SI	TYLCV, Ma, Mi, Mj
1	Beef	Red	Trust	De Ruiters/Bayer	280-220	Yes	ToMV:0-2/Ff:A-E/Fol:0,1/Sbl/Va:0/Vd:0	
2	Beef	Red	Caiman	Enza Zaden/Vitalis	220-240	Yes	ToMV:0-2,Ff:A-E,Fol:1,2,For,Va:1,Vd:1	On.
2	Beef	Red	Rebelski-7749	De Ruiters/Bayer	200-230	Yes	ToMV:0-2/ Ff:1-5/ Fol:0,1/ Va/ Vd	
4	Beef	Red	Kivu F1	Rijk Zwaan	260-280	Yes	TOMV:0-2/Ff:A-E/Fol:0,1/For/Va:0/Vd:0	On (ex Ol)
1	Cerise	Black	Black cherry	?		?		
1	Cerise	Orange	Esterina	?		?	ToMV:0-2,Ff:A-E,Fol:1,2,For,Va:1,Vd:1	Ma,Mi,Mj
1	Cerise	Pink	Sweet treat	Sakata	20-30	Yes	ToMV:0-2, Ff:A-E, Fol:1,2, For,Va:1, Vd:1	
1	Cerise	Red	Favorita	De Ruiters/Bayer	10-15	Yes	ToMV:0-2/Ff:A-E/Fol:0,1/For/Va:0/Vd:0	On (ex Ol)
2	Cerise	Orange	DR 3756	De Ruiters/Bayer		Yes		
2	Cerise	Orange	Orangita (DRTC8617)	De Ruiters/Bayer	11-16	Yes	ToMV:0-2/ToTV/Ff:A-E/Fol:0-1	Pst0/Lt/On/Ma/Mi/Mj
2	Cerise	Pink	Sunpeach	?	15-20	Yes	ToMV:0-2/Ff:A-E/Fol:0/For/Va:0/Vd:0	On (ex Ol)
2	Cerise	Red	Sakura	Enza Zaden/Vitalis	15-20	Yes		
1	Cerise allongée	Red	Bellacio	Gautier	10-14	Yes	ToMV:0-2/Fol:0/Pf:A-E	Ma/Mi/Mj
1	Cocktail	Red	Red Delight	De Ruiters/Bayer	45-50	Yes	Ff: A-E / Fol: 1, 2 / ToMV: 0-2/ Va/ Vd	Ma,Mi, Mi
2	Cocktail	Red	Amoroso (72-116)	Rijk Zwaan	35-40	Yes	For/Pst/ToMV:0-2/Fol:0 (US1-2)/Vd/Va/Ff:A-E	
2	Cocktail	Red	Annamay	Enza Zaden/Vitalis	35-40	Yes		
2	Cocktail	Red	Apéro	Gautier	18-20	No	ToMV:0-2/Fol:0/Pf:A-E	Ma/Mi/Mj
Interesting	Cocktail	Red	Brioso (72-130)	Rijk Zwaan	35-45	Yes	TOMV:0-2/Ff:A-E/Fol:0,1/For/Va:0/Vd:0/SI	On (ex Ol)

1- Greenhouse tomato cultivars:

Preference small scale farmer	Type	Color	Cultivar	Seed company	Fruit size (g)	Leaf mold resistance	HR	IR
1	On the vine	Jaune	Lorenzo	De Ruiter/Bayer	110-120	Non		
1	On the vine	Orange	Bolzano	De Ruiter/Bayer	100-110	Oui	Fol: 1 / ToMV: 0, 1	
1	On the vine	Rouge	Merlice	De Ruiter/Bayer	150-160	Oui	ToMV:0-2,Fol:1,2, Va:1, Vd:1	Pst:0, Ma, Mi, Mj
2	On the vine	Rouge	Maxeza	Enza Zaden/Vitalis	140-150	Oui	ToMV:0-2, Ff:A-E, Fol:1,2 For	ON/SI
1	Heirloom	Jaune	Margold	Gautier	190-250	Oui	ToMV:0-2/Va:0/Vd:0/Fol:0/Pf:A-E	
1	Heirloom	Noire	Marnouar	Gautier	190-250	Oui	ToMV:0-2/Fol:0/For/Pf:A-E	Ma/Mi/Mj/TYLCV
1	Heirloom	Rouge	Marsilla	Gautier	250-300	Oui	ToMV:0-2/Va:0/Vd:0/Fol:0/For/Pf:A-E	
1	Italienne	Rouge	Savantas	Enza Zaden/Vitalis	100-110	Oui		
2	Italienne	Rouge	Granadero	Enza Zaden/Vitalis	150	Non	ToMV:0-2/Lt/Va:0/Vd:0/Fol:0-1	TSWV/Ma/Mi/Mj
3	Italienne	Rouge	Prunus	De Ruiter/Bayer	90	Non	ToMV:0-2,Fol:1,2, Va:1, Vd:1	On
Très bon goût	Mini Plum	Rouge	Florantino	Rijk Zwaan	10-15	Non	TOMV:0-2/Fol:0-2/Va:0/Vd:0	Sbl/Ma/Mi/Mj
1	Mini San Marzano	Rouge	Delicassi	Gautier	25-30	Oui	ToMV:0-2/Fol:0/Pf:A-E	Ma/Mi/Mj
1	Raisin	Orange	Bamborange	Syngenta				
1	Raisin	Rouge	Apeticio	Gautier	9-12	Oui	ToMV:0-2/Fol:0/Pf:A-E	Ma/Mi/Mj
2	Raisin	Orange	Razolo	Gautier	10-14	Non	Va:0/Vd:0/Fol:0	
2	Raisin	Rouge	Capriccio	Gautier	8-10	Oui	ToMV:0-2/Fol:0/Pf:A-E	Ma/Mi/Mj
3	Raisin	Rouge	Anamaria	Rijk Zwaan	8-12	Non	ToMV:0-2/Fol:0,1	Ma/Mi/Mi
1	Round	Brune	Kakao	Gautier	130-150	Non	ToMV:0-2/Va:0/Vd:0/Fol:0	
1	Round	Rouge	Lutecia	Gautier	110	Oui	ToMV:0-2/Va:0/Vd:0/Fol:0,1/For/Pf:A-E	Ma/Mi/Mj/On
2	Round	Brune	Ebeno	Gautier	90-110	Non	ToMV:0-2/Va:0/Vd:0/Fol:0	

The background features abstract, overlapping geometric shapes in various shades of green, ranging from light lime to dark forest green. These shapes are primarily located on the right side of the slide, creating a modern, layered effect. The text is centered on a white background.

Some cultivars have incomplete
resistance pack.

Many soil diseases will find their
resistance only in the rootstocks.

1- Choose your greenhouse vegetable cultivars: Tomato resistance

Rootstock basic kit: (tomato and eggplant)

▶ **ToMV:0-2/Fol:0.1/For/PI/Va:0/Vd:0 Ma/Mi/Md**

- Pl = *Pyrenochaeta lycopersici* (corky root rot)
- Vd = *Verticillium dahliae* (race 0) exists 2 races
- Va = *Verticillium albo-atrum* (race 0)
- Ma/Mi/Mj = *Meloidogyne arenaria*, *incognita* and *javanica*

1- Rootstock cultivars:

Cultivar	Seed company	HR	IR	Power
Fortamino	Enza Zaden/	ToMV:0-2/Ff:A-E/Va:0/Vd:0/PI/Fol:0-2/For	TSWV/Ma/Mi/Mj	Balance
Kaiser	Rijk Zwaan	ToMV:0-2/Fol:0,1/For/PI/Va:0/Vd:0	Ma/Mi/Mj	Balance
Maxifort	De Ruiter/	ToMV:0-2/Fol:0,1/For/PI/Va:0/Vd:0	Ma/Mi/Mj	Strong

1- Choose your greenhouse vegetable cultivars: Resistances

Basic pack for greenhouse cucumbers:

- Ccu = *Cladosporium cucumerinum* (Cucumber scab)
- Cca = *Corynespora cassiicola* (target spot)
- PM = *Podosphaera xanthii* (Powdery mildew)
 - Mainly for late summer and fall

1- Types of cucumber cultivars

- Season: Some cultivars are not adapted to low light (October till January) vs genetic resistance to powdery mildew
- Adapted to high wire system vs umbrella system
 - Umbrella: Can work with all training system
 - High wire system: Some don't make as much sucker as required for umbrella system.
- Parthenocarpic Gynoecious :
 - Gynoecious means that the plant produces only female flowers;
 - Parthenocarpic means that the flower does not need to be pollinated for the fruit to develop.

European and Lebanese type cultivars are mostly of this type; there are also several American types

- Monoecious:
 - Means that the two types of flowers are found on the same plants.
 - Male flowers are dominant on the main stem early in growth and female flowers appear later.
 - On the suckers, these are almost exclusively female flowers

Most American type cultivars and field cultivars are mainly of this type.

How to choose a greenhouse vegetable cultivar

Cucumber

Preference small scale farmer	Preference high tech greenhouse	Type	Cultivar	Seed Company	Length (cm)	Fruit weight (g)	Powdery mildew	Cca	Ccu	CMV	CVYV	CGM - MV	Res, HR	Rés. IR	Winter	Spring	Summer	Fall	Umbrella	High Wire
1		Slicing	Corinto	Enza Zader	20-25		I			I	I					X	X	X		
2		Slicing	Paraiso	Enza Zader	20-22		I			I	I		CYSDV							
1		English	Kalunga	Enza Zader	31-34		H	H	H								X		X	
2		English	Verdon	Rijk Zwaan	32-38		H	H	H	I	I	H				X	X	X	X	
3		English	Eldora	De Ruiter	31-35		H	I	H							X	X		X	
4		English	Logica	De Ruiter	34-42		H									X	X	X	X	
5		English	Tyria	Enza Zader	33-36		I	H	H											
1		English	Camaro	De Ruiter	32-36	400-500	I								X			X	X	
1		Cocktail	Ministars	De Ruiter	7-9		I		H						HPS	X	X			X
1		Cocktail	Quazy	Rijk Zwaan	10		I		H						HPS	X	X			X
1		Pickle	Excelsior																	
1		Lebanese	Katrina	Enza Zader	14-16		I		H	I	I	I							X	
1		Lebanese	Socrates	Enza Zader	17-18		I		H											
1	1	Lebanese	Jawell	De Ruiter	10-15	90-110	I			I	I				X	X	X		X	X
	2	Lebanese	Bonwell	Rijk Zwaan	15		I		H	I	I	X			X	X	X	X		

1- Pepper cultivars

Pepper		
Blocky	Red	Sprinter
		Morraine
	Orange	Milena
	Yellow	Eurix
		Brocanto
	Striker	
Pointed	Red	Carmen

2- Determine the quality criteria of the transplants: tomatoes

- ▶ Aim for the production of strong and vigorous transplants
- ▶ Foliage/root balance for rapid rooting
 - ▶ Root air pruning
- ▶ Desired planting stage:
 - ▶ Tomato: 8-10 true leaves or first flower open at 50% of plants



2- Determine the quality criteria of the transplants: cucumbers

- ▶ Aim for the production of strong and vigorous transplants
- ▶ Foliage/root balance for rapid rooting
- ▶ Desired planting stage:
 - ▶ Cucumbers: 4-5 true leaves



Ontario plant propagator limited

2- Determine the quality criteria of the transplants: peppers

- ▶ Aim for the production of strong and vigorous transplants
- ▶ Foliage/root balance for rapid rooting
- ▶ Desired planting stage:
 - ▶ Peppers: First Y clearly visible



2- Determine the quality criteria of the transplants: eggplants

- ▶ Aim for the production of strong and vigorous transplants
- ▶ Foliage/root balance for rapid rooting
- ▶ Desired planting stage:
 - ▶ Eggplants: 12 inches tall

3- Determine densities according to your type of greenhouse

- ▶ Type 1: High luminosity greenhouse with CO₂ injection.
- ▶ Type 2: High luminosity greenhouse without CO₂ injection or medium luminosity greenhouse with CO₂ injection.
- ▶ Type 3: Medium luminosity greenhouse without CO₂.
- ▶ Type 4: Low light greenhouse without CO₂.



See detailed definitions of greenhouse types in last winter's training.

Generally, you are either a type 2 or 3!

3- Determine your densities: tomato heads/m²

Greenhouse type	Tomato			
	Beef			Cherry
	Medium	Large	X-large	
	190-210g	220-250g	>270g	
1	3,2	2,8	2,5	3,8
2	2,8	2,4	2,2	3,3
3	2,4	2,1	1,9	2,9
4	2,1	1,8	1,7	2,5

3- Determine your densities: cucumber Heads/m²

- ▶ The density varies according to the trellising technique used:
 - Umbrella
 - High wire

Greenhouse type	Cucumber			
	English		Lebanaise	
	High wire	Umbrella	High wire	Umbrella
1	2,5	1,8	3,5	2,5
2	2,2	1,6	3,0	2,2
3	1,9	1,4	2,6	1,9
4	1,7	1,2	2,3	1,7

3- Determine your densities: pepper heads/m²

- Choice of densities Pepper: heads/m²

Greenhouse type	Pepper	
	Blocky	Pointed
1	6,5	8,5
2	5,6	7,3
3	4,9	6,4
4	4,3	5,6

3- Determine your densities: eggplant g/strate/m2

$(\text{g/stratum}) / \text{caliber} = \text{heads /m}^2$

Ex: for a type 2 greenhouse and a 400g fruit size Italian eggplant cultivar, we would do the following calculation:

$$\frac{2147 \text{ g per stratum}}{400 \text{ g/fruit}} = 5,36 \text{ heads/ m}^2$$

Greenhouse type	Eggplant
	g/strate
1	2475
2	2147,0
3	1863,7
4	1640,1

4- Determine the number of plants to produce

- ▶ To make the correct calculations, we need the following information:
 - ▶ The length of the beds
 - ▶ Bed width*
 - ▶ The number of beds per crop and cultivar
 - ▶ Densities
 - ▶ Do we graft?
 - ▶ Do we double the heads?

*We calculate the width of the bed from center to center of 2 beds.

The pathway included.

4- Determine the number of plants to produce

- ▶ The calculation file will be provided to you.
- ▶ Enter the information in the purple boxes only

If you have difficulties with Excel, we will help you, of course!

4- Determine the number of plants to produce

- ▶ Start by indicating your bed dimensions in meters.

Planning 2023		Length(m) board	Width(m)	m ² /bed
Farm		30,00	1,60	48,00
			*1 ft = 0.3048 m	

4- Determine the number of plants to produce

- ▶ Depending on the crop, choose the line that corresponds to your situation: beef , cherry, grafted, non-grafted, double head or single head.

Crop	Type	Cultivar	Particularity	Bed type (no. of wire)
TOMATOES	Cherry tomato Rootstock		Grafted - Double Head	Double
	Tomato Beef Rootstock		Grafted - Double Head	Double
	Cherry tomato		Non-grafted - Double-headed	Double
	Tomato Beef		Non-grafted - Double-headed	Double
	Cherry tomato		Not grafted - single head	Double
	Tomato Beef		Not grafted - single head	Double

*the same questions arise for eggplant!

4- Determine the number of plants to produce

- For cucumbers, choose the type of cultivar and the type of pruning chosen.

Crop	Type	Cultivar	Particularity	Bed type (no. of wire)
CUCUMBERS	English		umbrella	Double
	American		umbrella	Double
	Lebanese		umbrella	Double
	English		High wire	Double
	American		High wire	Double
	Lebanese		High wire	Double

4- Determine the number of plants to produce

- Then, indicate the number of beds and the density according to your type of greenhouse for each cultivar.

Crop	Type	Particularity	Number of bed	Densities			Area	Desired pots final
				Head density/m ²	nb head per pot	Pot density/m ²	m ²	
TOMATOES	Cherry tomato	Grafted - Double Head	1	3,3	2	1,65	48,0	79
	Rootstock		1	3,3	2	1,65	48,0	79
	Tomato Beef	Grafted - Double Head	1	2,4	2	1,2	48,0	58
	Rootstock		1	2,4	2	1,2	48,0	58
	Cherry tomato	Non-grafted - Double-headed	1	3,3	2	1,65	48,0	79
	Tomato Beef		1	2,4	2	1,2	48,0	58
	Cherry tomato	Not grafted - single head	1	3,3	1	3,3	48,0	158
	Tomato Beef		1	2,4	1	2,4	48,0	115

4- Determine the number of plants to produce

- It is important to provide an excess % to compensate for losses from poor germination, grafting and transplanting.

Crop	Type	Particularity	Number of bed	Number of seeds and seedlings needed						
				Desired pots final	% excess seeding	Sowing	% excess graft	Grafted	% transplanting excess	Transplanted
TOMATOES	Cherry tomato	Grafted - Double Head	1	79	1,50	119	1,25	99	1,10	87
	Rootstock		1	79	1,50	119	1,25			
	Tomato Beef	Grafted - Double Head	1	58	1,50	86	1,25	72	1,10	63
	Rootstock		1	58	1,50	86	1,25			
	Cherry tomato	Non-grafted - Double-headed	1	79	1,25	99			1,10	87
	Tomato Beef	Non-grafted - Double-headed	1	58	1,25	72			1,10	63
	Cherry tomato	Not grafted - single head	1	158	1,25	198			1,10	174
	Tomato Beef		1	115	1,25	144			1,10	127

4- Determine the number of plants to produce

- ▶ In the case of cucumbers and beans, provide only the % seeding
- ▶ The seedlings are done directly in the 4 inches pot.

Crop	Type	Particularity	Number of bed	Number of seeds and seedlings needed						
				Desired pots final	% excess seeding	Sowing	% excess graft	Grafted	% transplanting excess	Transplanted
CUCUMBERS	English	umbrella	1	77	1,25	96				
	American	umbrella	1	77	1,25	96				
	Lebanese	umbrella	1	106	1,25	132				
	English	High wire	1	106	1,25	132				
	American	High wire	1	106	1,25	132				
	Lebanese	High wire	1	144	1,25	180				

5- Determine the space needed in the nursery

- ▶ Principles:
 - ▶ Plants never touch each other
 - ▶ Plants double their leaf area every 4 days
- ▶ Things to consider:
 - ▶ Usually; we space once.

5- Determine the space needed in the nursery: seedlings

- ▶ Enter the number of cavities of the multicell used for sowing.
- ▶ We recommend sowing every 2 cells to balance the air space versus the roots ex: $128/2 = 64$
- ▶ Larger cells can be used for rootstock because the transplants will stay in the cell longer.

Crop	Type	Particularity	Number of seeds and seedlings needed		Multicells		Space (ft ²)
			Sowing	Transplanted	Multi cell type	No. Trays	Sowing
TOMATOES	Cherry tomato	Grafted - Double Head	119	87	64	1,86	2,78
	Rootstock		119		36	3,30	4,95
	Tomato Beef	Grafted - Double Head	86	63	64	1,35	2,03
	Rootstock		86		36	2,40	3,60
	Cherry tomato	Non-grafted - Double-headed	99	87	64	1,55	2,32
	Tomato Beef	Non-grafted - Double-headed	72	63	64	1,13	1,69
	Cherry tomato	Not grafted - single head	198	174	64	3,09	4,64
	Tomato Beef	Not grafted - single head	144	127	64	2,25	3,38

5- Determine the space needed in the nursery: Pots

- ▶ Enter the type of pot used to calculate the space needed in the nursery.
- ▶ 6 inch pots for tomatoes, peppers and eggplant
- ▶ 4 inch pots for cucumbers and beans.
- ▶ It is necessary to plan a spacing of the pots in the nursery before entering the greenhouse, to ensure that the transplants do not touch each other.

Crop	Type	Particularity	Number of seeds and seedlings needed		Space (ft ²)			
			Sowing	Transplanted	Sowing	Pot diameter	Transplanting	At 12 heads/m ² density
TOMATOES	Cherry tomato Rootstock	Grafted - Double Head	119	87	2,78	6,00	22	156
	119		4,95					
	Tomato Beef Rootstock	Grafted - Double Head	86	63	2,03	6,00	16	114
	86		3,60					
	Cherry tomato	Non-grafted - Double-headed	99	87	2,32	6,00	22	156
	Tomato Beef		72	63	1,69	6,00	16	114
	Cherry tomato	Not grafted - single head	198	174	4,64	6,00	44	156
	Tomato Beef		144	127	3,38	6,00	32	114

5- Determine the space needed in the nursery: Pots

- ▶ In the case of cucumbers and beans, the table takes into account the sowing space in pots and not in multicells
- ▶ Enter the type of pot used to calculate the space needed in the nursery.

Crop	Type	Particularity	Number of seeds and seedlings needed		Multicells		Space (ft ²)		
			Sowing	Transplanted	Multi cell type	No. Trays	Sowing	Pot diameter	Transplanting
CUCUMBERS	English	umbrella	96				10,67	4,00	
	American	umbrella	96				10,67	4,00	
	Lebanese	umbrella	132				14,67	4,00	
	English	High wire	132				14,67	4,00	
	American	High wire	132				14,67	4,00	
	Lebanese	High wire	180				20,00	4,00	

5- Space required for transplanting



5- Spacing is necessary in the nursery



5- Pots with 2 heads require more space!

one-headed plant



Plant with 2 heads



5- Determine the spacing between the pots when planting

- ▶ The table will take into account the length of the row and the number of pots desired to determine the spacing between the pots.

Crop	Type	Particularity	Bed type (no. of wire)	Number of bed	Desired pots final	Spacing between pots at planting	
						inch	cm
TOMATOES	Cherry tomato	Grafted - Double Head	Double	1	79	14 15/16	37,88
	Rootstock			1	79		
	Tomato Beef	Grafted - Double Head	Double	1	58	20 8/16	52,08
	Rootstock			1	58		
	Cherry tomato	Non-grafted - Double-headed	Double	1	79	14 15/16	37,88
	Tomato Beef			1	58		
	Cherry tomato	Not grafted - single head	Double	1	158	7 7/16	18,94
	Tomato Beef			1	115		

6- Determine the sowing schedule

- ▶ According to culture
- ▶ Time of year (winter or spring sowing)
- ▶ Harvest start date
- ▶ Various techniques:
 - ▶ Grafting
 - ▶ Double head

6- Determine the sowing schedule

- ▶ The times presented are for spring sowing by a well-established and experienced grower.
- ▶ These deadlines will have to be extended if :
 - ▶ Sowing takes place before January 15: + 14 days
 - ▶ If it is the first time that we graft: + 7 days
 - ▶ If temperatures are lower than recommended: total delay + 10% for each 1°C held colder.
- ▶ It is recommended to plan a longer period and to shorten it from year to year, according to the experience gained.

6- Determine the sowing schedule

Crop	Type	Particularity	Duration in days						
			Sowing	graft	transplanting *	spacing	Spacing-planting	Planting-harvesting	Total duration (d)
TOMATOES	Cherry tomato	Grafted - Double Head	14	7	13	14	7	50	105
	Rootstock		17						
	Tomato Beef	Grafted - Double Head	14	7	14	13	7	56	111
	Rootstock		17						
	Cherry tomato	Non-grafted - Double-headed	14		13	14	7	50	98
	Tomato Beef		14		13	14	7	56	104
	Cherry tomato	Not grafted - single head	14		7	14	7	50	92
Tomato Beef	14			7	14	7	56	98	

6- Determine the sowing schedule

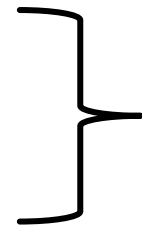
- ▶ The dates are calculated according to the stages for each culture.

Crop	Type	Particularity	Date						
			Sowing	Graft	Transplanting	Nursery spacing	Greenhouse spacing	Planting	Harvest
CUCUMBERS	English	umbrella	22-Apr-23			4-May-23	17-May-23	18-May-23	15-Jun-23
	American	umbrella	26-Apr-23			8-May-23	21-May-23	22-May-23	15-Jun-23
	Lebanese	umbrella	26-Apr-23			8-May-23	21-May-23	22-May-23	15-Jun-23
	English	High wire	22-Apr-23			4-May-23	17-May-23	18-May-23	15-Jun-23
	American	High wire	26-Apr-23			8-May-23	21-May-23	22-May-23	15-Jun-23
	Lebanese	High wire	26-Apr-23			8-May-23	21-May-23	22-May-23	15-Jun-23

7- Layout of the sowing chamber

- ▶ Artificial lighting
 - Fluorescent
 - HPS
 - LEDs
 - Tomatoes 20% and more blue (avoid LEDs)
 - White curtain = light reflection

- ▶ Heater
- ▶ Ventilation
- ▶ Fogger



Curtain
management
and
Thermometer (soil
and air)

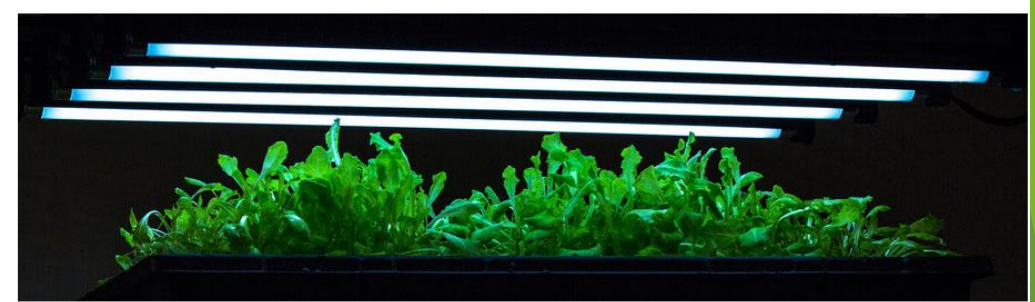


7- Layout of the sowing chamber : Artificial lighting

Fluorescent:

- ▶ Need 40W/m² in the PAR*
 - ▶ Between 400 and 700 nm
 - ▶ Objective: 12 moles/m²/day
 - ▶ + losses = 15 moles/m²/day
- ▶ 54W T5 fluorescents
 - ▶ 6400K (lots of blue)
 - ▶ Ex: Sunblaster T5HO 54w
 - ▶ 3730 lumens = 85.79 $\mu\text{Mole}/\text{m}^2/\text{sec}$ at 6400 K
 - ▶ 16 hrs = 4.94 moles /m²/day
 - ▶ Otherwise, mix Cool white and Grow light
- ▶ 16-18 hours/day
- ▶ Consideration of heat emission

* PAR = Photosynthetically active radiation



SunBlaster T5HO Combo Selection

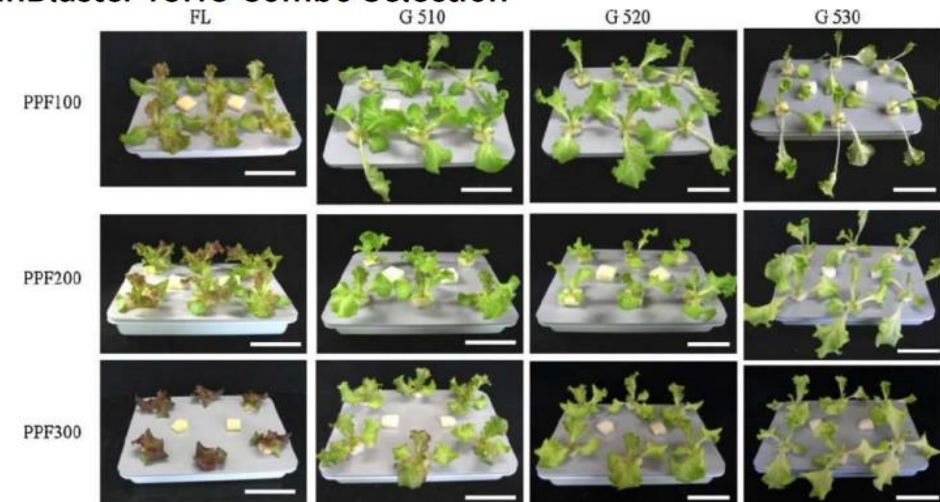


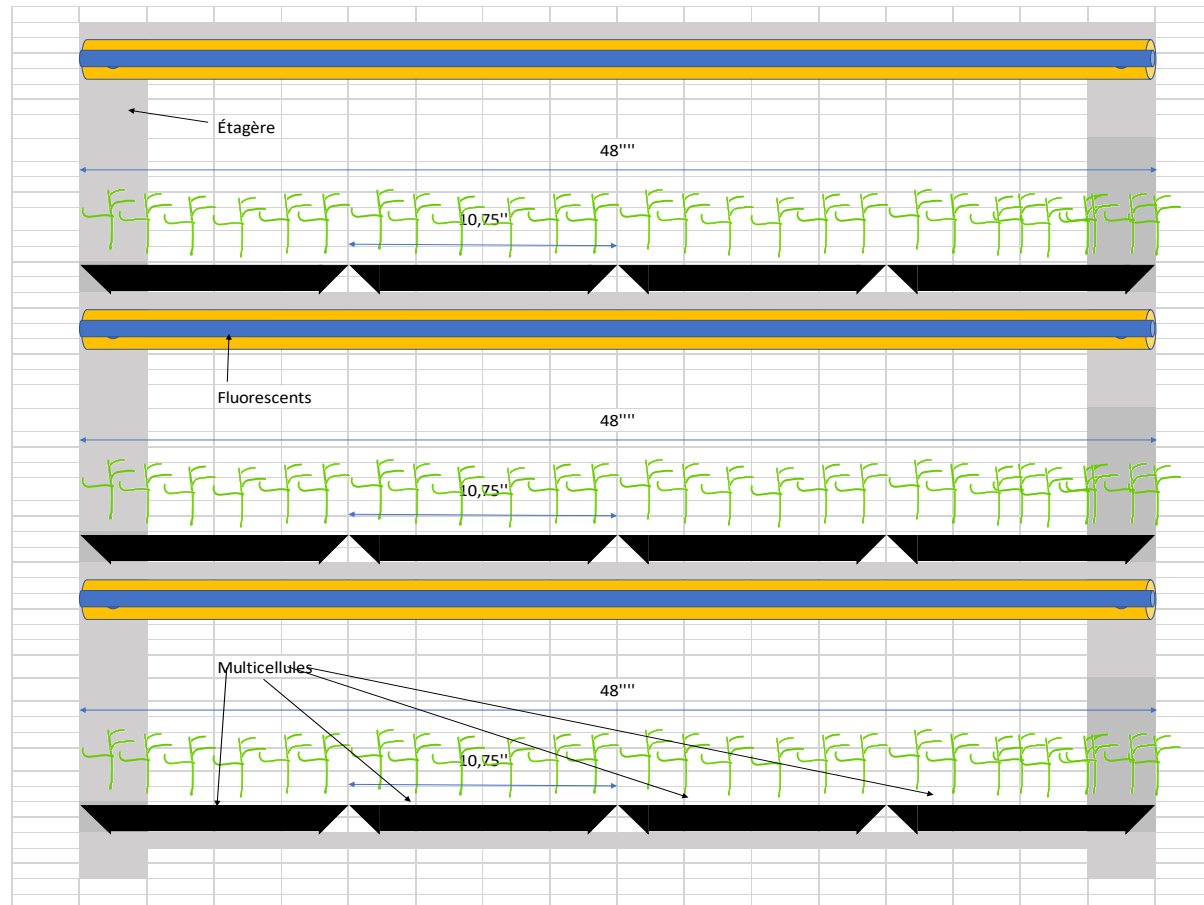
Fig. 2. Morphology of red leaf lettuce plants treated with light from a white fluorescent lamp (FL) and green light-emitting diodes (LED). Peak wavelength for each LED was 510 nm (G510), 524 nm (G520) and 532 nm (G530). Plants were photographed 17 d after sowing. Bars indicate 8 cm. Total photosynthetic photon flux was 100, 200 and 300 $\mu\text{mol m}^{-2} \text{s}^{-1}$. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of the article.)

7- Layout of the sowing chamber : shelves

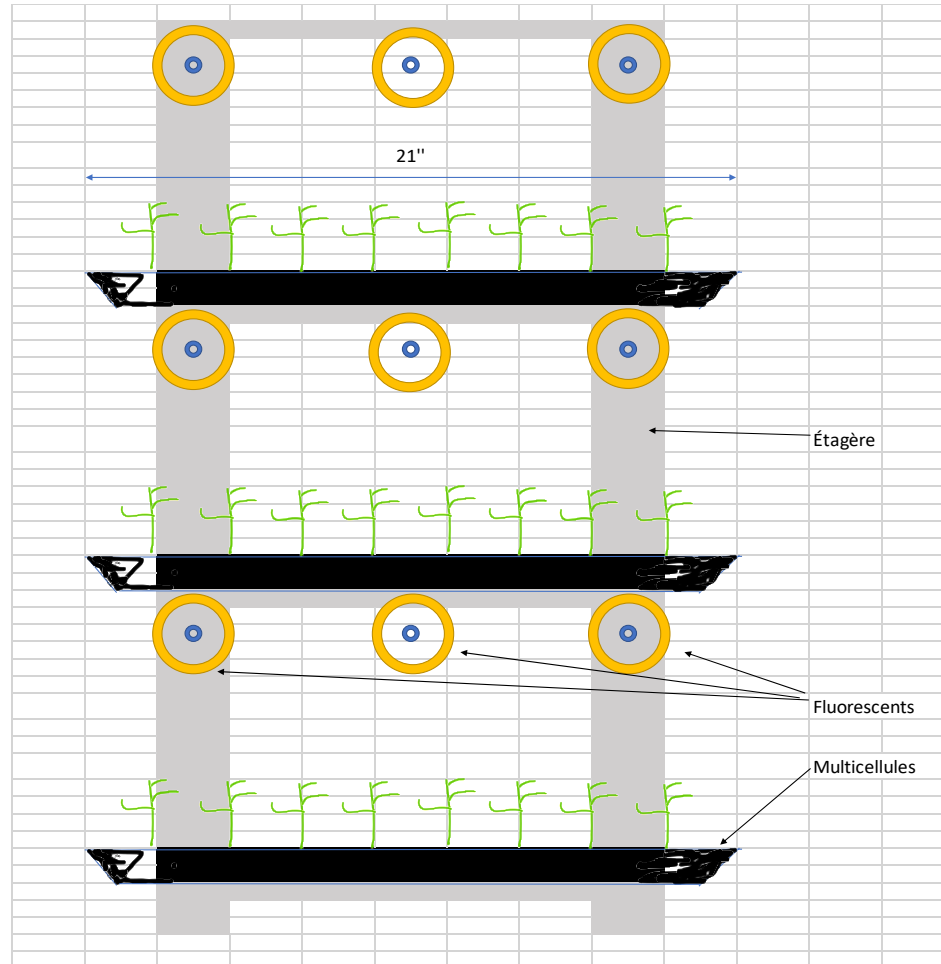
- ▶ There should be a minimum of 16 inches between shelves to allow for shelf, plants, domes, lights and to achieve proper light and temperature distribution.



7- Layout of the sowing chamber : Shelves



7- Layout of the sowing chamber : Shelves



7- Layout of the sowing chamber : Heating

- ▶ During the photoperiod
 - ▶ Lighting provides a large portion of heating needs.
- ▶ During the night:
 - ▶ Dragon or electric baseboard controlled by a thermostat (precise).
- ▶ Alarms!



7- Nursery layout: HPS artificial lighting

- ▶ Whether or not artificial lighting is needed for transplants depends on the time of year and where the transplants will be prepared.
- ▶ It is necessary for:
 - ▶ Greenhouse transplants from November to mid-January
 - ▶ Indoors transplants
- ▶ 40 W/m² in PAR in buildings, 17 W/m² in greenhouses
- ▶ 16-18 hours/day,
- ▶ 12 moles/m² /day = Sun + lighting
- ▶ HPS create less shading than fluorescents
- ▶ The heat emission must be taken into account.



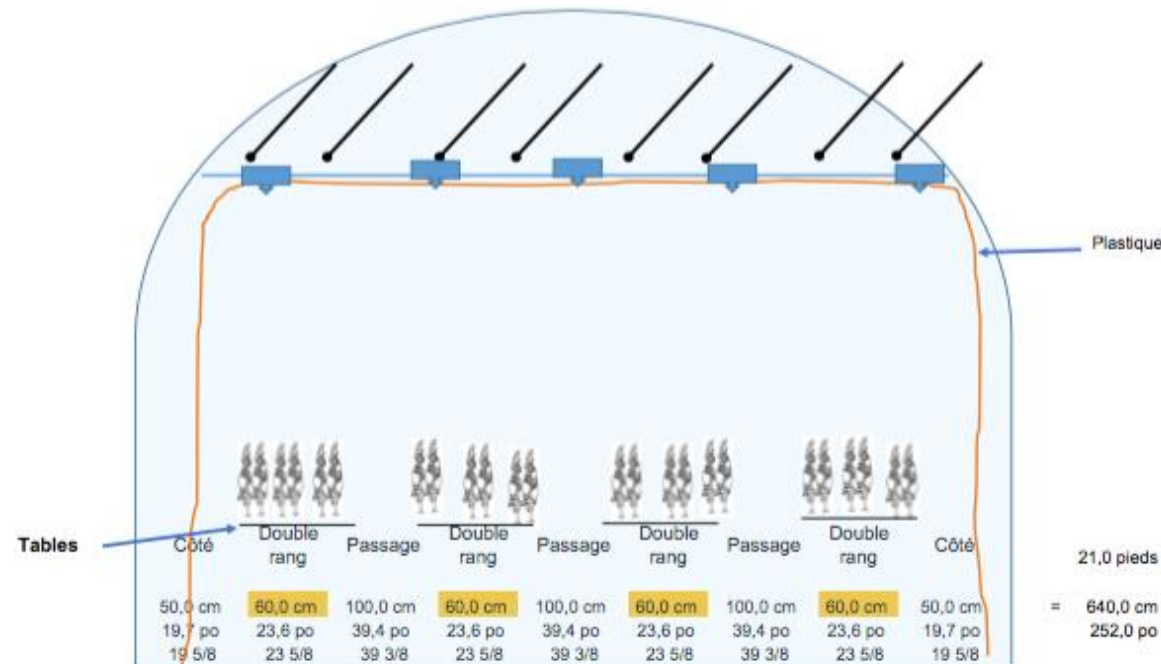
*Greenhouse transplants after January 15: no need for artificial lighting!

7- Development of the **nursery** : space for propagation

- ▶ It is possible to install a propagation space in the greenhouse to take advantage of natural light and have enough space.
- ▶ Provide:
 - ▶ Heat
 - ▶ Ventilation
 - ▶ Tables
 - ▶ Irrigation system

7- Development of the **nursery** : space for propagation

- Generally close 1/3 of the length of the greenhouse for adequate heating capacity at this time of year.



7- Development of the **nursery** : space for propagation

- ▶ Cold room... for seedlings:
 - ▶ OK for seedlings or grafted plants
 - ▶ Be aware to acclimatize
 - ▶ If MH or HPS lighting
 - ▶ Heat and humidity management problem
- ▶ Basement:
 - ▶ Depending on the lighting ...
 - ▶ Heat and humidity management problem

7- Development of the **nursery** : space for propagation



7- Development of the **nursery** : space for propagation



7- Development of the **nursery** : space for propagation



8- Choice of substrates: hydroponics

Sequence of substrates: respect the capillarity

Table 1 : From the most humid to the driest

Table 1 : From the most humid to the driest				
	Stage			
	Plantation	Transplantation	Sowing	Sucking
S u b s t r a t e	Rockwool	Rockwool	Rockwool	No
	Sawdust	Rockwool	Rockwool	No
	Peat mix	Peat mix	Peat mix	No
				Yes
	Coco fiber	Rockwool	Rockwool	Yes
	Soil	?	?	Yes/No

8- Choice of substrates: **hydroponics**

Rockwool (seedling/germinating medium)

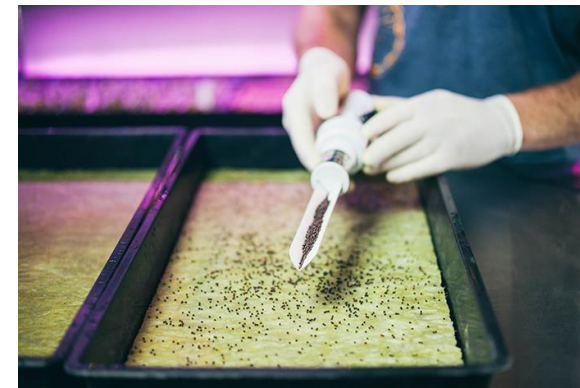


Kiem Plug (staked crops)



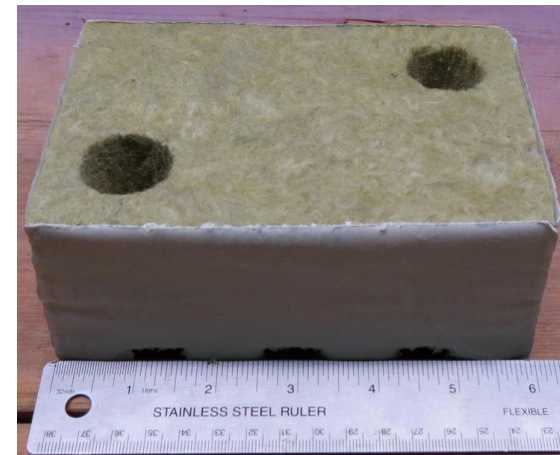
Leafy plants: Lettuce, herbs

Microgreens and baby leaf:
broadcast sowing



8- Choice of substrates: hydroponics

Rock wool: Transplanting cube
10 X 10 X 7.5 cm
10 X 15 cm X 7.5 cm



8- Choice of substrates: **hydroponics**

Rockwool Sowing: Variant between staked crops

- ▶ Tomato, pepper and eggplant: Slow growth and tolerance to transplanting
 - ▶ Sowing in Kiem Plug under fine vermiculite
 - ▶ Transplanting in a 4X4 cube (1 plant with 1 or 2 heads) or 4X6 (2 plants with one head, pay attention to the direction of lowering)
- ▶ Cucumber: Rapid growth and poor tolerance to transplanting
 - ▶ Sowing in a 4 x 4 cube under medium perlite in the hole of the transplanting cube

8- Choice of substrates: hydroponics

coconut fiber



Jiffy Preformed



8- Choice of substrates: **hydroponics**

coconut fiber

- ▶ Three possible scenarios
 - ▶ Coco sowing + Coco transplanting + Coco plantation
 - ▶ Very intuitive management often causing errors during planting
 - ▶ Sowing rockwool + coconut transplanting + coconut plantation
 - ▶ Kiem Plug dries too quickly
 - ▶ Very intuitive management often causing errors during planting
 - ▶ Sowing rockwool + transplanting rockwool + coconut plantation
 - ▶ Well-known management when planting; mastery of all stages
- ▶ The coconut cube rewet very badly if it dries too much.

8- Choice of substrates: **hydroponics**

Peaty mix

- ▶ Sowing/germinating mixes (Fafard, Berger)
- ▶ Transplanting mixes = Planting mixes (Fafard, Berger)

8- Choice of substrates: hydroponics

Peaty mix

- ▶ Multicell : 128 sow $1/2 = 64$ per tray = good aerial/root ratio
- ▶ Transplanting in a double pot (pot-in-pot = 1st pot without bottom which will be placed on the growing medium)
 - ▶ 6 inches (tomato, pepper and eggplant)
 - ▶ 4 in (cucumber and beans)
- ▶ Planting: Watering as needed; follow the roots; do not force the root penetration
 - ▶ The first watering can occur after several days

8- Choice of **biological substrates** : Seedling/germinating mixes

▶ Goals

- ▶ Low electrical conductivity
- ▶ Good capillarity with the seed (fine texture)

▶ House blend:

▶ 7 parts

- ▶ 1 compost
- ▶ 3 peat moss
- ▶ 2 vermiculite
- ▶ 1 mineral soil
- ▶ Beware of too much compost
- ▶ Digestion/Preservation (manufacture before use)

8- Choice of **biological substrates** : Seedlings/germinating mixes

- ▶ house mix

- ▶ Optimal concentration:

- ▶ $EC \leq 0.75\text{mS/cm}$

- ▶ $\text{pH} \approx 5.8$

- ▶ N: 40-60ppm

- ▶ P: 4-8ppm

- ▶ K: 50-100ppm

- ▶ Ca: 60-120ppm

- ▶ Mg: 30-50ppm

8- Choice of **biological substrates** : Seedling/germinating mixes

▶ Commercial mixtures:

- ▶ Berger; OM2 (the most used)
- ▶ Fafard ; Agromix OS
- ▶ Lambert; LM-18
- ▶ Premier Tech; Promix PG

8- Choice of **biological substrates** : Transplanting mixes

▶ Goals

- ▶ EC \approx 2.0 mS /cm
- ▶ pH \approx 5.8

▶ house mix

- ▶ 8 parts =
 - ▶ 2 compost
 - ▶ 3 medium peat moss
 - ▶ 2 vermiculite
 - ▶ 1 mineral soil

8- Choice of **biological substrates** : Transplanting mixes

▶ Commercial mixtures:

- ▶ Berger; OM6
- ▶ Fafard; Agromix O2 (very popular)
- ▶ Lambert; LM-111
- ▶ Premier Tech; Promix MP organic

8- Choice of **biological substrates** : Transplanting mixes

Attention!

- ▶ Cucumber sown in 4-inch pots in seedling mix because they are sensitive to high salinity.

8- Choice of **biological substrates** : Transplanting mixes

- ▶ Sowing soil + compost + etc... ok ?

Be aware!

- ▶ Sowing soil \neq Transplanting soil.

9- Choice of **organic containers**

- ▶ Tray without separation; ±???
- ▶ Multicellular Trays
- ▶ 128 used @50% for rootstocks

Where

- ▶ 98 used @50% for rootstocks
- ▶ 98 used @100% for scions

9- Choice of organic containers

- ▶ Seed trays
- ▶ Drain holes



9- Choice of **organic containers**: choice of pots

▶ 6 inches for crops that stay in the pot for a long time:

- ▶ Tomatoes
- ▶ peppers
- ▶ eggplant



▶ 4 inches: for fast crops:

- ▶ Cucumbers
- ▶ Beans



10- Graft equipment

- ▶ Blades
- ▶ Clamps of different sizes
- ▶ Plastic domes (watch out for the greenhouse effect)
- ▶ Spray
- ▶ Shade cloth if grafted in a greenhouse.



11- Other small equipment

- ▶ Electrical conductivity reader (salinity)
- ▶ pH meter (hydroponics)
- ▶ Soil thermometer



11-Other small equipment

- ▶ Access to water is important in the nursery
- ▶ Soft watering nozzle for seedlings
- ▶ Soft pommel for transplants
- ▶ Flow valve
- ▶ Stakes and ties

Avoid soaking the trays from below!

- ▶ Perfect for distributing seed or substrate diseases



<https://dutchgreenhouseprojects.com/>



12- Fertilization of transplants

Remember to have some fertilizers on hand to be able to react to fertility declines as needed:

- ▶ Fish emulsion or liquid seaweed
- ▶ Actisol (5-3-2) in small pellets

Thanks!

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