GRAFTING IN FRANCE

A national survey to evaluate the complete picture of the situation

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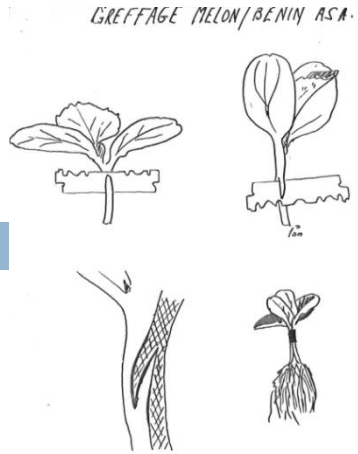
A bit of history

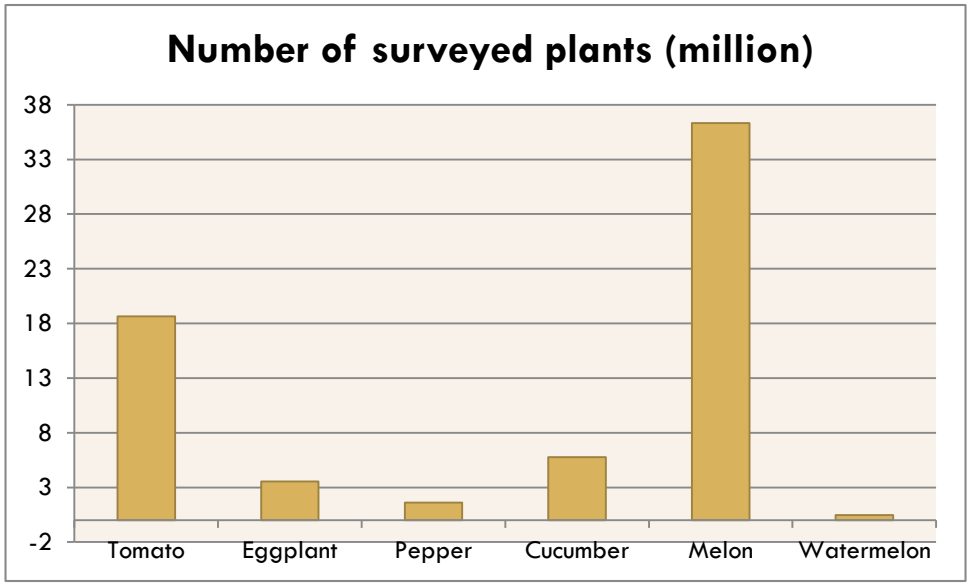


- Grafting has developed in France since the 60's with some pioneers (Louvet, 1954)
- First grafted crops: tomato; melon (*Benincasa cerifera*)
- Now, experts in vegetable grafting are rare, and mainly working for seed companies
- No detailed knowledge on current use of grafting was available, only tendency/trends

  => national survey to evaluate grafting in France

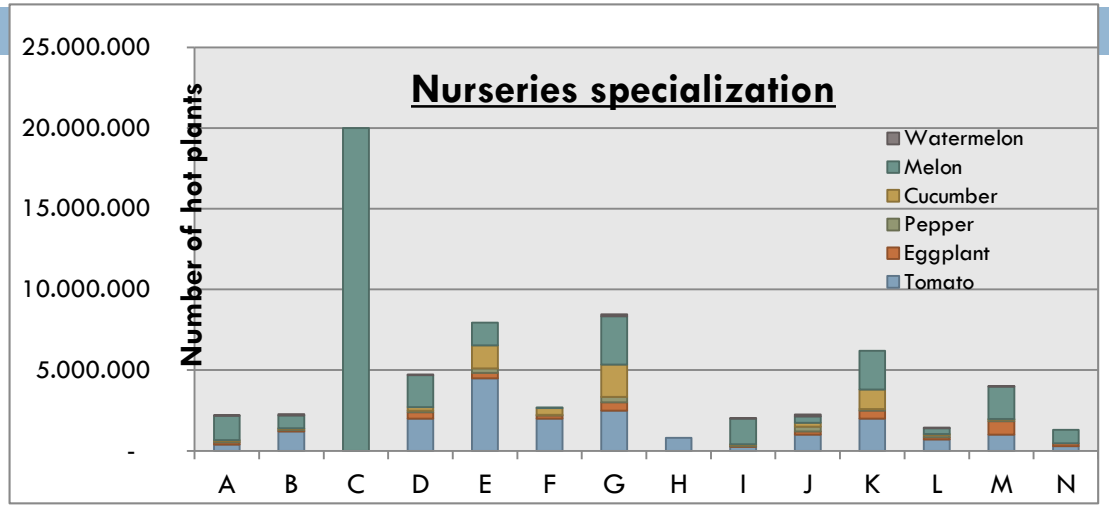
Sampling

- 14 French nurseries + 1 Dutch nursery selling in France
- A total of 66 million hot plants
  - 36,3 million melon
  - 18,6 million tomato
  - 5,77 million cucumber



General comments

- Diversified nurseries



- A small amount of plants supplied by French nurseries

	Cultivated area (ha)	Planting density (plants/ha)	Total number of plant ESTIMATED	Total number of plant DATA COLLECTED	Reprensentative results?
Soiless tomato	1 277	12 500	15 962 500		
Soil tomato	577	10 000	5 770 000	18 643 100	86%
Eggplant	475	20 000	9 500 000	3 534 000	37%
Pepper	466	20 000	9 320 000	1 612 000	17%
Cucumber	550	12 500	6 875 000	5 774 000	84%
Melon	13 916	7 500	104 370 000	36 820 000	35%
Watermelon	822	5 000	4 110 000	468 000	11%

=> Import? Home made production?

Percentage of grafted plants

- Methodology
  - Based on the representativeness rate of the results
    - If high, $\text{percentage of grafted plants} = \frac{\text{number of grafted plants surveyed}}{\text{Total number of plants surveyed}}$
    - If low, hypothesis are formulated and confirmed by experts

	Cultivated area (ha)	Planting density (plants/ha)	Total number of plants	Grafted plants SURVEYED	Non grafted plants SURVEYED	Total number of plants SURVEYED	Representativeness
Watermelon	822	5000	4 110 000	145 500	322500	468000	11,4%

Low representativeness

Hypothesis B : We surveyed all grafted plants but only a part of non grafted plants
3,5% of grafted plants

Hypothesis A : The sample is representative
31% of plants are grafted

Melon and cucumber

Melon

	Cultivated area (ha)	Planting density (plants/ha)	Total number of plants	Grafted plants SURVEYED	Non grafted plants SURVEYED	Total number of plants SURVEYED	Representativeness
Melon	13916	7500	104 370 000	10 645 500	25 674 500	36 320 000	34,8%

Hypothesis B : We surveyed all grafted plants and only a part of non grafted plants

Grafted areas = 10,2 %

Hypothesis A : the sample is representative

Grafted areas = 29.3 %

Cucumber: (380 ha heated greenhouse +109 ha non heated greenhouse)

	Cultivated area (ha)	Planting density (plants/ha)	Total number of plants	Grafted plants SURVEYED	Non grafted plants SURVEYED	Total number of plants SURVEYED	Representativeness
Cucumber	550	12 500	6 875 000	1 732 380	4 041 620	5 774 000	84%

Ratio:

30% of grafted plants

Eggplant and pepper

Eggplant

	Cultivated area (ha)	Planting density (plants/ha)	Total number of plants	Grafted plants SURVEYED	Non grafted plants SURVEYED	Total number of plants SURVEYED	Representativeness
Eggplant	475	20 000	9 500 000	2 211 000	1 323 000	3 534 000	37%

Hypothesis A : we surveyed the main nurseries that graft plants
=> 23% of grafted plants

Hypothesis B : The sample is representative
=> 63% of grafted plants

Low representativeness

Pepper

	Cultivated area (ha)	Planting density (plants/ha)	Total number of plants	Grafted plants SURVEYED	Non grafted plants SURVEYED	Total number of plants SURVEYED	Representativen
Pepper	466	20000	9320000	319500	1292500	1 612 000	17,3%

Low representativeness

Hypothesis A : we surveyed the main nurseries that graft plants
=> 3,4% of grafted plants

Hypothesis B : The sample is representative
=> 20% of grafted plants

Tomato

	Cultivated area (ha)	Planting density (plants/ha)	Total number of plants	Grafted plants SURVEYED	Non grafted plants SURVEYED	Total number of plants SURVEYED	Representativeness
Soiless tomato	1 277	12 500	15 962 500	14 420 100	4 223 000	18 643 100	86%
Soil tomato	577	10 000	5 770 000				

Hypothesis A : Representativity is high:
If we do not distinguish soilless and soil cultivation, 77.4% of tomatoes are grafted

BUT: we know that 90% of plants produced in soiless greenhouse are grafted

We evaluated 86% of total production so if we would have surveyed all plants, we would have 16,81 million of grafted plants and 4,92 million of non grafted plants

14,366 millions of grafted plants for soiless production

2,44 millions of grafted plants for soil production

=> 42.35% of soil tomato are grafted and 90% of soiless tomatoes

Main rootstocks used

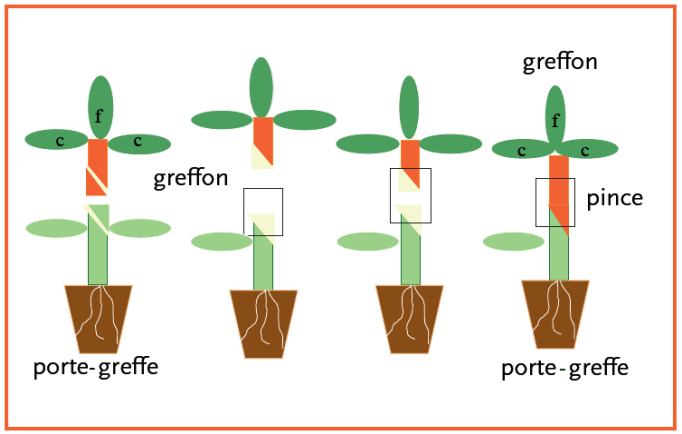
- Tomato: *Solanum lycopersicum* S. habrochaïtes*
  - Maxifort (12) ; Emperador (11); DRO 141 (6)

  + Beaufort, Stallone (RZ), Optifort, Protector
- Cucumber: *Cucurbita maxima * Cucurbita moschata*
  - TZ 148, RS 841, Azman
- Melon: *C. melo* or *Cucurbita maxima * Cucurbita moschata*
  - Dinero (12), Magnus (4), Sphinx (2) Neffiac (2)
  - TZ 148, RS 841
- Eggplant
  - Maxifort (8); Beaufort (7); Emperador (4), Solanum torvum, DRO 141
- Pepper
  - Snooker (4); Capsifort (6); Brutus (3), Antinema (1)
- Watermelon: *Cucurbita maxima * Cucurbita moschata*
  - TZ 148, RS 841

Grafting method and reasons for grafting

- Grafting method:
  - Japanese grafting

  (splice grafting, tube grafting)



Greffage par application ou greffe à la japonaise

- Why grafting?
  - Tomato => Vigor, yield
  - Melon => grafting on interspecific hybrids for cold resistance and vigor and grafting on intraspecific hybrids for Fusarium resistance
  - Cucumber => vigor
  - Eggplant => Verticillium, Fusarium, Corcky Root Pythium…Low temperature

  Vigor and yield
  - Pepper => phythophthora, nematodes

Last remarks, conclusions and perspectives

- **Evolution** variable according to each crop
  - Stable for tomato, cucumber and eggplant
  - Unknown for melon
  - Pepper: could increase if adapted rootstock
- Rootstock **diversity** is not sufficient for certain crops such as pepper and eggplant
- For some crops, grafting does not increase **costs** compared to non grafting (tomato, melon)
- **Negative effects** of grafting are rarely observed by nurseries
- **Automation**? Not used but could increase
- **Further research**?

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Thanks for your attention

Questions ?