

Systems and techniques for growing plants in pumice substrate: Tips to avoid mistakes during installation of the crop



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What does the term of «Hydroponic Cultivation» indicate?

The cultivation system where:

- Roots are growing not in natural soil but in substrates or into pure nutrient solutions (NFT)
- The supply of water and nutrients is conducted through the provision of a nutrient solution



Main reasons for growing plants in Hydroponic Cultivation Systems

- 1.Radical elimination of soil-borne diseases
- 2.Balanced and controlled nutrition through nutrient solution
- 3.Higher yield of produce even in arid lands
- 4.Early plant production
- 5.Maximizing use of water and fertilizer by recycling



Commercial Production Area of Greek Hydroponic Greenhouses

- Tomato: **850 acres**
- Cucumber: **450 acres**
- Lettuce **50 acres**
- Other Vegetables and Ornamentals(Rosa, Gerbera):**150 acres**
- Total: **1.500 acres**



Substrate's basal functions

1. Water Supply
2. Oxygen supply
3. Proper and balanced nutrition ensurance
4. Plant support



Desirable substrate characteristics

1. Structure Stability
2. Ability to retain water and air in a stable equivalence
3. Uniformity in composition, appearance and behavior in terms of nutrition
4. Free of pathogens, animal pests and weed seeds
5. Easy handling during cultivation practice
6. Relatively low cost



What is pumice?

- Aluminosilicate volcanic rock
- Mined in the island of Nisyros (Gyali)
- Chemically unactive with extensive porosity
- Formation of granules => solidified when super-heated, highly pressurized rock is violently ejected from a volcano (simultaneous actions of rapid cooling and rapid depressurization)



Common Uses of Pumice

1. Vegetable Hydroponic Cultivations
2. Ornamental Hydroponic Cultivations
3. Component of substrate mixture for growing pot plants
4. Mold Component for growing out- or indoor plants
5. Soil Improvement
6. Soil drainage and Turf Improvement
7. Landscaping



Physical Characteristics of Greek Pumice

Granule size (mm)	E_{ϕ} BD (g cm ⁻³)	P_a (% v/v)	A_{cc} (% v/v)	EAW (% v/v)	WBC (% v/v)
0-2	0.952	53.1	13.5	7.14	2.27
0-5	0.938	51.0	14.3	8.23	2.00
0-8	0.829	53.0	19.7	4.76	1.54
4-8	0.620	62.0	38.7	1.07	0.57

Different Granule Texture



Different Physical Properties



Cultivation performances of the different Granule Pumice types

1. Best granule size for greenhouse cultivations is 0-8 mm
2. Smaller granule sizes (eg. 0-2 mm) provide higher yields only through the use of a thicker layer (> 15 cm)
3. Thicker granules aren't suggested due to lower water availability
4. Suggested that the thicker granules are used:
 - i. Use of smaller layer (up to 8 – 10 cm)
 - ii. Frequent irrigation with a smaller water dosage per irrigation



Pumice Granule Sizes in Greek Market

- 0-3 mm
- 0-8 mm
- 2-10 mm
- 0-16 mm



Benefits raised from Pumice usage for Greek farmers

1. Natural material of very high mechanical strength mined in Greece
2. Lower production and transportation costs compared to other imported and non- hydroponic substrates
3. Very low cost



Systems and techniques for growing plants in pumice substrate

1. Bags
2. Containers (pots, etc.)
3. Channels



1. Cultivation in bags filled with Pumice substrate



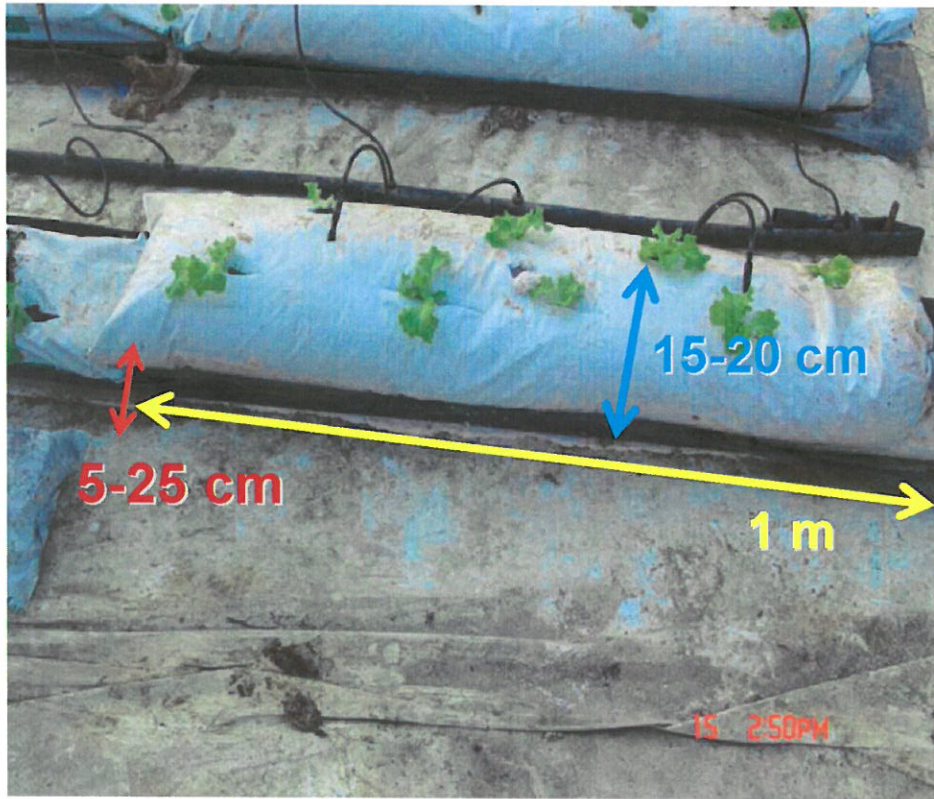
Manufacture of the bag filled with pumice

- White color low density polyethylene
- Black inner surface (blocking passage of light)



Bag adjustment manners

1. Horizontally on the floor of greenhouse



2. Fitted into the channel area



Mistake avoidance when installing the crop in pumice bags

Frequent Mistake:

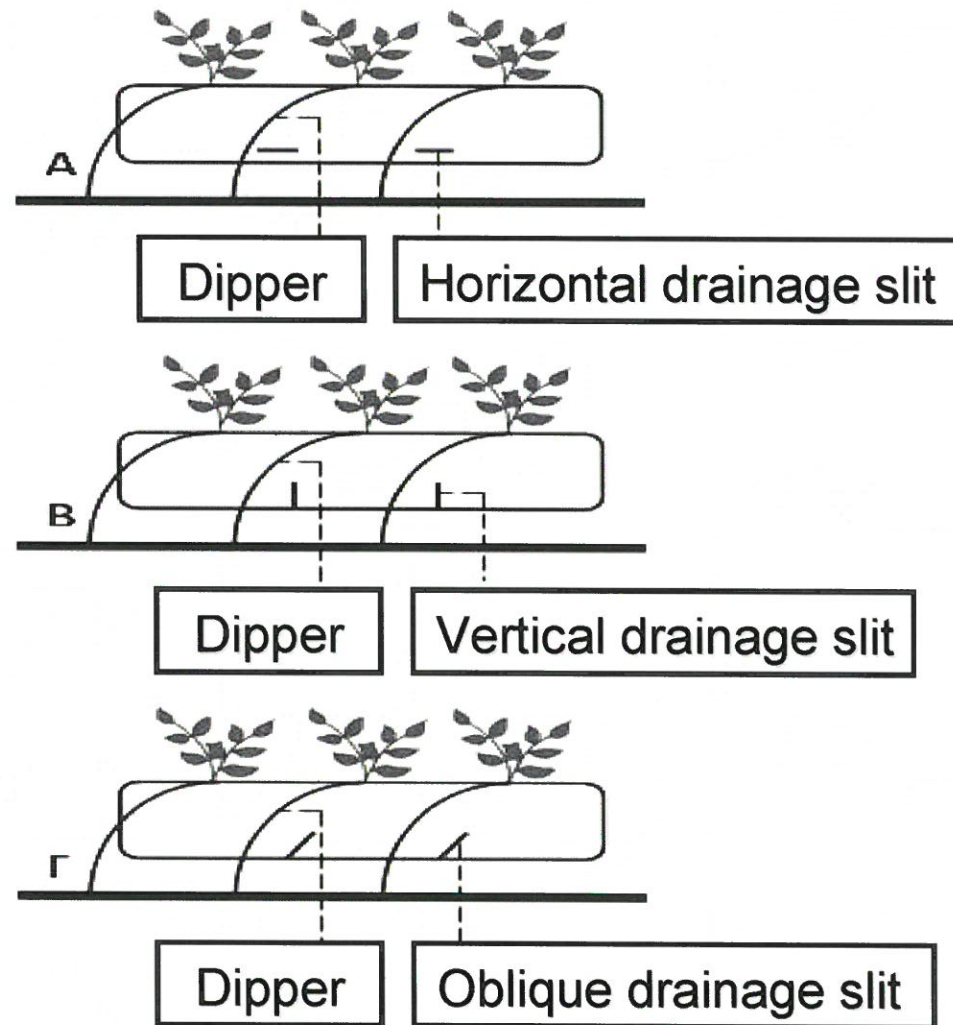
1. Faulty design of drainage slit

Good practice:

1. Engraving on one side of the bag
2. Develop a slit up to the bottom of the pumice bag for complete water drainage



Different ways of the drainage slit creation on the pumice bags



2. Cultivation in pots filled with Pumice substrate



Cultivation in pots filled with Pumice substrate

- 1.Extra greenhouse labor demanding for filling pots with pumice
- 2.Offset by the low price of the pumice in bulk form



Mistake avoidance when installing the crop in pots filled with pumice

Frequent Mistake:

Obstruction of nutrient solution's flow into the drainage water collection system

Good practices:

1. Use gutter (channels) with grooves on the bottom
2. Support with appropriate metal columns so as to prevent bottom resting on a support base



A. Gutter (channels) with grooves on the bottom



B. Appropriate metal columns which prevent bottom resting on a support base



3. Cultivation in channels filled with Pumice substrate



Arranging channels on the floor of greenhouse

Necessity for floor
coverage with
black-white plastic



Loading channels on benches or other restraints

Suitable for:

- 1. Plants forming a rosette (lettuce gerbera, etc.)**
- 2. Short plants (roses, zucchini, etc.)**



Channel characteristics

- Width: 15-40 cm
 - Single line (15 – 25 cm)
 - Double or Multiple lines (> 30 cm)
- Height: 5-25 cm
- Length: Depending on the greenhouse size



Mistakes avoidance when installing the crop in channels filled with pumice

1st Frequent Mistake:

Disparity in levels of substrate moisture along the channel because of the slope

Good practice:

Double bottom channels usage



Mistakes avoidance when installing the crop in channels filled with pumice

2nd Frequent Mistake:

Formation of algae and weeds and pumice over-warming

Good practice:

Coverage of the upper surface with a sheet of soft plastic (milky white exterior and black interior)

- White: increases brightness at lower parts and minimizes pumice solar absorption
- Black: intercepts exposure of pumice to light



Mistakes avoidance when installing the crop in channels filled with pumice

3rd Frequent Mistake: Wrong pumice volume usage per plant

Good practice:

- 2-3 liters per plant when plants are planted densely (e.g. chrysanthemum, lettuce)
- up to 12 liters per plant in crops with sparse planting (e.g. cucumber)



Mistakes avoidance when installing the crop in channels filled with pumice

4th Frequent Mistake:

Low pumice volume in the channel (<15 cm)

Good practice:

Loading pumice in the channel at a height of at least 15 cm



Thank you for your attention!



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