Porous Alpha Technical Sheet

What is “Porous Alpha”?

1.Structure of Porous Alpha

The Porous Alpha is a foamed glass with numerous pores, produced by burning pulverized glass mixed with a foaming agent such as shell powder or calcium carbonate ($CaCO_3$).

Composition of Porous Alpha

Element	% to total
SiO_2	62.0%
CaO	24.7%
Na_2O	8.6%
K_2O	2.0%
Al_2O_3	1.7%
Fe_2O_3	1.0%

(Elements less than 1.0% of total composition are eliminated)

2. Using Porous Alpha as soil amendment

If Porous Alpha is mixed with soil, the water retention capacity of the soil is increased, because the pores of Porous Alpha catch and retain water which otherwise infiltrates in the sol. Porous Alpha can retain water for 15% of its total volume. The dosage of Porous Alpha is 10% of the soil volume, around 5L Porous Alpha for each 1 meter line of ridge.

Alpha Porous retains 15% water of its total volume

3. Safe Use of Porous Alpha for agriculture

Porous Alpha is compliant to Japanese soil environmental standard. Based on the result of leaching test, the utilization of Porous Alpha doesn‘t have any problem related to heavy metal and toxic product to use it as the soil including mixing with soil.

Leaching test result according to "Environmental regulations on contamination of soils“

Article	Result	Standard
Alkyl Mercury	Not detected	Not detected
Total mercury	< 0.0005 mg/l	0.0005mg/l
Cadmium	< 0.001 mg/l	0.01mg/g
Lead	0.001 mg/l	0.01mg/l
Organophosphorus	Not detected	Not detected
Hexavalent chromium	0.014mg/l	0.05mg/l
Arsenic	< 0.001mg/l	0.01mg/l
Total Cyanogen	Not detected	Not detected
PCB	Not detected	Not detected
Trichloroethylene	< 0.03 mg/l	0.03mg/l
Tetrachlorethylene	< 0.01 mg/l	0.01mg/l
Dichloromethane	< 0.02 mg/l	0.02mg/l
Carbon tetrachloride	< 0.002mg/l	0.002mg/l
1,2 - Dichloroethane	< 0.004 mg/l	0.004mg/l
1,1 - Dichloroethane	< 0.02mg/l	0.1mg/l
Cis 1,2 - Dichloroethylene	< 0.04 mg/l	0.04mg/l
1,1,1 - trichloroethane	< 0.3 mg/l	1mg/l
1,1,2 - trichloroethane	< 0.006 mg/l	0.006mg/l
1.3 - Dichloropropene	< 0.002 mg/l	0.002mg/l
Thiuram	< 0.006 mg/l	0.006mg/l
Simazine	< 0.003 mg/l	0.003mg/l
Thiobencarb	< 0.02 mg/l	0.02mg/l
Benzene	< 0.01 mg/l	0.01mg/l
Selenium	< 0.001 mg/l	0.01mg/l
Fluorine	< 0.08 mg/l	0.8mg/l
Boron	< 0.1 mg/l	1mg/l
Copper	< 0.5 mg/kg	125mg/kg

August 23, 1991 Ministry of the Environment), Analysis by the association Tottori health, Jan. 2008

4.Other characteristics of Porous Alpha

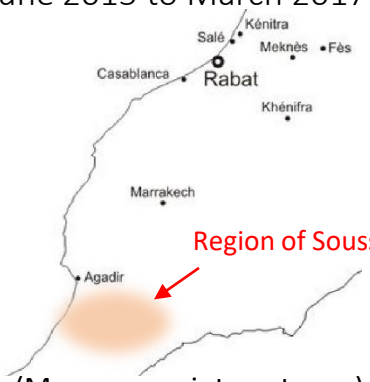
Article	Data
Water retention capacity	15% of the volume of Porus Alpha
Visual appearence	Achroma or light green etc.
Hydraulic transmissivity	10^{-3} - 10^{-2} cm/sec
Odor	Odorless
True density	Ca 2,5 g/cm^3
Density of the size	0,5 – 1,1 g/cm^3
Grain size	50～2,000 µm (Median 700µm)*
grain shape	Amorphous form
pH	Max. pH 10.3 or pH7 (After watering)
Solubility	No
Softening temperature	720～730℃
Volatile	No
Hydraulic transmissivity	10^{-2} – 10^{-3} cm/sec

Experimentation results in Morocco

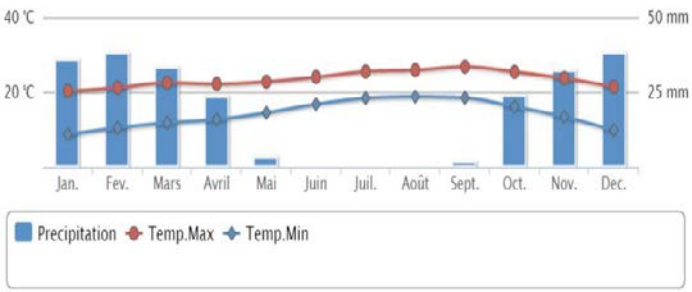
These are results of experimentation in Morocco from June 2015 to March 2017

1. Project Outline

- Location: Sidi-Bibi, Souss-Massa, Morocco
- Project Site: Centre for Technical Adaptation and Extension (CATV)
- Partner institution: Regional Office of Agricultural Development of Souss-Massa (ORMVASM), Ministry of Agriculture and Fisheries of Morocco.
- Target Vegetables: Tomato / Green Bean
- Green house
- Irrigation method: Drip Irrigation



(Map: www.pinterest.com)



(climatic condition of Souss-Massa Region by: France Weather Service)

2.Method of experimentation

For **the tomato** and **the green bean**, the three conditions on the irrigation volume and two conditions on the existence of Porous Alpha are set.

List of experimentation conditions

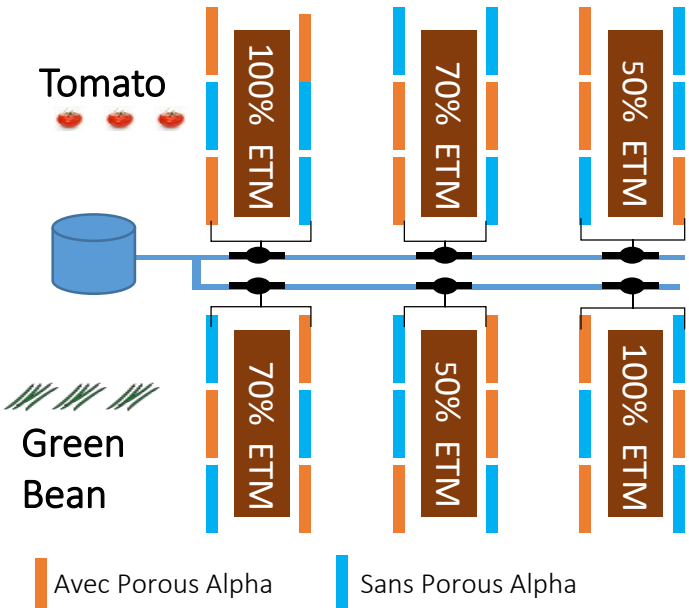
Condition Number	Quantity of irrigation	Presence of Porous Alpha
1	100% ETM	Without Porous Alpha
2	100% ETM	With Porous Alpha
3	70% ETM	Without Porous Alpha
4	70% ETM	With Porous Alpha
5	50% ETM	Whithout Porous Alpha
6	50% ETM	With Porous Alpha

(ETM : Maximum evapotranspiration)

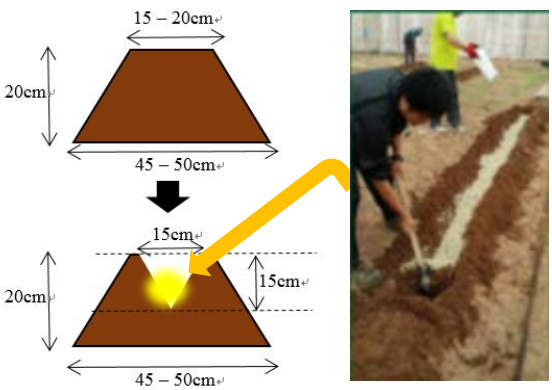
Inputs other than irrigation water

Article	Quantity
Humic acid injection	10 l/ha
Rooting (BioRoot)	5l/ha
Amino acid injection	5l/ha
Iron injection (Sequestrene)	2 kg/ha
Potenza (humic acid)	2 kg
Installation of hives	4 ruches /ha
Humistore (humic acid)	10 l/ha
Iron injection (Sequestrene)	3 kg
Humistore (humic acid)	10 l/ha

Layout of experimentation conditions

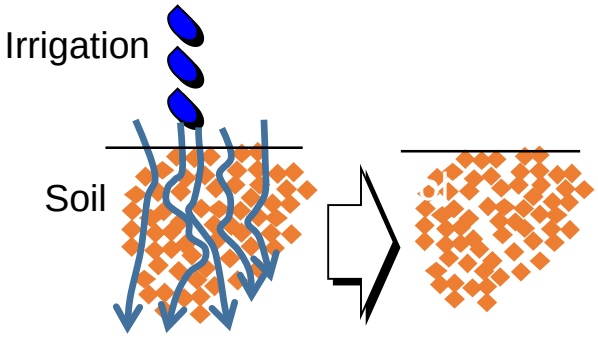


Application Method to mix Porous Alpha in ridges



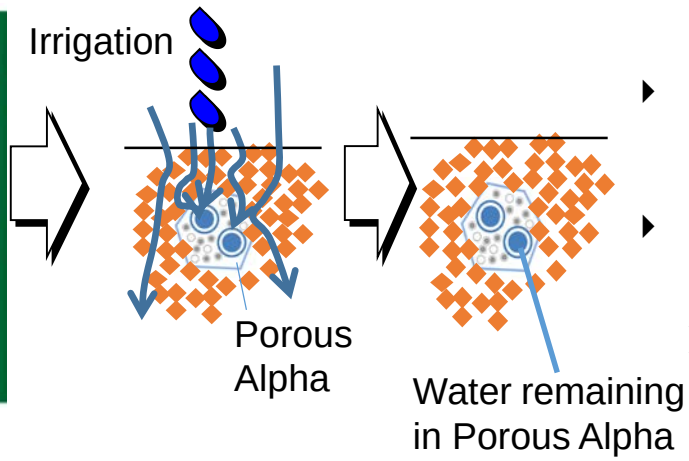
3. Mechanism of the function of Porous Alpha

Soil without Porous Alpha



- In sandy soil, the infiltration is quite fast
- There're lots of lost water, including liquid fertilizer

Soil with Porous Alpha

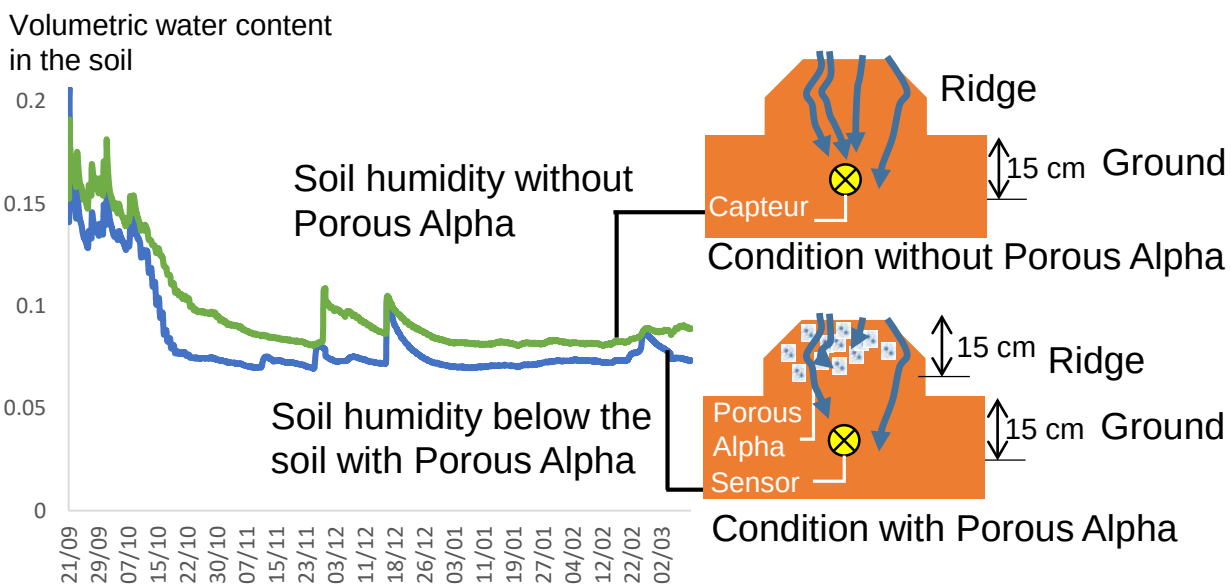


- Porous Alpha catches the infiltrating water in the soil
- Liquid fertilizer is also retained in the Porous Alpha. It realize the better yield

4. Difference of soil humidity in the soil after the water retention by Porous Alpha

- The humidity sensor is set in the soil under the soil area with Porous Apha
- As Porous Alpha catches the water, the soil humidity in the soil under the Porous Alpha is less than the condition without Porous Alpha

The soil humidity for the irrigation condition of 50% of maximum evapotranspiration



5.Results of the harvest in the experimentation

For the case of tomato

The difference of the harvest and the water efficiency between conditions

Result of the 1st season (September 2015 – April 2016)

Drip Irrigation	Porous Alpha	Yield*1	Irrigation volume per 1ha	Water efficiency*2	Ratio of exportable product*3
100%	Without Porous Alpha	74.6 t/ha	4,077m^3	18.3 kg/m^3	82.1%
	With Porous Alpha	97.5 t/ha		23.9 kg/m^3	84.0%
70%	Without Porous Alpha	73.3 t/ha	2,904m^3	25.2 kg/m^3	80.8%
	With Porous Alpha	107.0 t/ha		36.8 kg/m^3	86.2%
50%	Without Porous Alpha	67.0 t/ha	2,115m^3	31.7 kg/m^3	80.4%
	With Porous Alpha	95.2 t/ha		45.0 kg/m^3	85.1%

Result of the 2nd season (September 2016 – March 2017*4)

Drip Irrigation	Porous Alpha	Yield*1	Irrigation volume per 1ha	Water efficiency*2	Ratio of exportable product*3
100%	Without Porous Alpha	20.2 t/ha	1,495 m^3	13.5 kg/m^3	76.0 %
	With Porous Alpha	18.5 t/ha		12.4 kg/m^3	80.3 %
70%	Without Porous Alpha	19.4 t/ha	1,077 m^3	18.0 kg/m^3	81.6 %
	With Porous Alpha	22.6 t/ha		21.0 kg/m^3	83.2 %
50%	Without Porous Alpha	21.5 t/ha	803 m^3	26.8 kg/m^3	80.4 %
	With Porous Alpha	24.2 t/ha		30.1 kg/m^3	72.8 %

*1 : Harvest is measured with five sampled plants. Yield is calculated based on the plantation density per hectare.
*2 : Water Efficiency (kg/m3) = Yield (t/ha) / Irrigation volume for 1 ha (m3) * 1000
*3: Ratio of exportable product = Harvest under the category of Calibre 2 ~ 4 / Total harvest
*4: The 2nd harvest was finished at the end of March due to the serious damage by Tuta

For the case of green bean

The difference of the harvest and the water efficiency between conditions

Result of the 1st season – Round bean (September 2015 – December 2015)

Drip Irrigation	Porous Alpha	Yield*1	Irrigation volume per 1ha	Water efficiency*2	Ratio of exportable product*3
100%	Without Porous Alpha	48,1 t/ha	843 m^3	57,1 kg/m^3	72,6 %
	With Porous Alpha	58,3 t/ha		69,2 kg/m^3	75,0 %
70%	Without Porous Alpha	42,3 t/ha	615 m^3	68,8 kg/m^3	68,7 %
	With Porous Alpha	53,6 t/ha		87,1 kg/m^3	73,6 %
50%	Without Porous Alpha	43,4 t/ha	462 m^3	93,9 kg/m^3	73,7 %
	With Porous Alpha	58,5 t/ha		126,6 kg/m^3	74,6 %

Result of the 2nd season – Flat bean (September 2016 – December 2016)

Drip Irrigation	Porous Alpha	Yield*1	Irrigation volume per 1ha	Water efficiency*2	Ratio of exportable product*3
100%	Without Porous Alpha	20,6 t/ha	912 m^3	22,6 kg/m^3	90,1 %
	With Porous Alpha	24,9 t/ha		27,3 kg/m^3	88,3 %
70%	Without Porous Alpha	16,9 t/ha	674 m^3	32,7 kg/m^3	88,3 %
	With Porous Alpha	20,3 t/ha		43,1 kg/m^3	84,9 %
50%	Without Porous Alpha	16,8 t/ha	515 m^3	25,0 kg/m^3	89,5 %
	With Porous Alpha	22,2 t/ha		30,2 kg/m^3	91,0 %

*1 : Harvest is measured with five sampled plants. Yield is calculated based on the plantation density per hectare.
*2 : Water Efficiency (kg/m3) = Yield (t/ha) / Irrigation volume for 1 ha (m3) * 1000
*3: Ratio of exportable product = Harvest under the category of Fin & Ex.Fin / Total harvest

6. Evaluation of environmental impact on fruit (Tomato)

In the experiment, the physicochemical characteristics and the presence of heavy metals in fruit are evaluated.

Results of **chemical analysis** on tomato for the 1st season (Analyzed by AGQ)

		Without Porous Alpha				With Porous Alpha				T-test
Article	Unit	100%	70%	50%	Average	100%	70%	50%	Average	p-value
Boron	mg/kg	< 5.00	< 5.00	< 5.00	NA	< 5.00	< 5.00	< 5.00	NA	NA
Calcium	%	0.5	0.07	0.11	0.23	0.09	0.08	0.04	0.07	0.32
Copper	mg/kg	<5.00	< 5.00	< 5.00	NA	< 5.00	< 5.00	< 5.00	NA	NA
Iron	mg/kg	110	21.3	25.5	52.27	24	31.7	17.5	24.40	0.39
Magnesium	%	0.4	0.08	0.13	0.20	0.1	0.13	0.06	0.10	0.35
Manganese	mg/kg	<5.00	< 5.00	< 5.00	NA	< 5.00	< 5.00	< 5.00	NA	NA
Molybdenum	mg/kg	<10.0	< 10.0	< 10.0	NA	< 10.0	< 10.0	< 10.0	NA	NA
Phosphorus	%	0.58	0.13	0.19	0.30	0.17	0.21	0.1	0.16	0.39
Potassium	%	2.87	3.01	3.48	3.12	3.03	3.57	2.73	3.11	0.98
Sodium	mg/kg	<250	< 250	< 250	NA	< 250	< 250	< 250	NA	NA
Sulfur	%	0.15	0.06	0.08	0.10	0.08	0.08	0.06	0.07	0.45
Zinc	mg/kg	5	< 5.00	< 5.00	5.00	< 5.00	< 5.00	< 5.00	NA	NA
Chlorine	mg/kg	2188	3605	3840	3.211.00	3475	3671	4541	3.895.67	0.33
Dumas nitrogen	%	3.62	1.55	1.71	2.29	1.5	1.81	1.51	1.61	0.37

Results of **chemical analysis** on tomato for the 2nd season (Analyzed by Labomag)

		Withoug Porous Alpha				With Porous Alpha				T-test
Article	Unit	100%	70%	50%	Average	100%	70%	50%	Average	p-value
Boron	% DM	13	9.4	12.1	11.50	12.1	10.8	11.0	11.30	0.44
Calcium	% DM	0.1	0.05	0.03	0.06	0.06	0.09	0.14	0.10	0.31
Copper	mg/kg DM	5.25	5.71	4.52	5.16	5.06	5.98	5.04	5.36	0.69
Iron	mg/kg DM	35.55	51.39	40.18	42.37	50.3	42.93	51.77	48.33	0.33
Magnesium	% DM	0.22	0.21	0.2	0.21	0.19	0.25	0.24	0.23	0.44
Manganese	mg/kg DM	11.66	10.89	8.53	10.36	11.47	12.95	13.11	12.51	0.12
Phosphorus	% DM	0.34	0.3	0.27	0.3	0.3	0.3	0.28	0.29	0.66
Potassium	% DM	3.27	3.34	3.41	3.34	3.34	3.34	3.66	3.45	0.40
Sodium	mg/kg	199.82	298.41	281.46	259.90	177.38	233.94	175.68	195.67	0.15
Zinc	mg/kg DM	15.85	15.86	12.86	14.86	19.02	18.72	15.34	17.69	0.14
Chlorine	% DM	0.58	0.62	0.62	0.61	0.57	0.63	0.72	0.64	0.51
Nitrogen	% DM	1.28	1.57	1.49	1.45	1.54	1.83	1.58	1.65	0.18

Result of **heavy metal** contents in the fruit of tomato for 1st season (Analyzed by AGQ)

		Without Porous Alpha				With Porous Alpha				T-test
Article	Unit	100%	70%	50%	Average	100%	70%	50%	Average	p-vallue
Cadmium	mg/kg	< 0.01	< 0,01	< 0,01	N.A.	< 0,01	< 0,01	< 0,01	N.A.	N.A.
Chromium	mg/kg	< 0,10	< 0,10	< 0,10	N.A.	< 0,10	< 0,10	< 0,10	N.A.	N.A.
Copper	mg/kg	< 1,00	< 1,00	< 1,00	N.A.	< 1,00	< 1,00	< 1,00	N.A.	N.A.
Mercury	mg/kg	< 0,04	< 0,04	< 0,04	N.A.	< 0,04	< 0,04	< 0,04	N.A.	N.A.
Nickel	mg/kg	< 0,05	< 0,05	< 0,05	N.A.	< 0,05	< 0,05	< 0,05	N.A.	N.A.
Lead	mg/kg	0,06	0,03	0,03	0,04	0,02	0,03	0,04	0,03	0,22
Zinc	mg/kg	2,04	1,08	2,85	1,99	1,02	1,34	< 1,00	N.A.	N.A.

Result of **heavy metal** contents in the fruit of tomato for 2nd season (Analyzed by Labomag)

		Without Porous Alpha				With Porous Alpha				T-test
Article	Unit	100%	70%	50%	Moyenne	100%	70%	50%	Moyenne	p-valeur
Cadmium	mg/kg	<0.02	<0.02	<0.02	N.A.	<0.02	<0.02	<0.02	N.A.	N.A.
Chromium	mg/kg	< 0.1	< 0.1	< 0.1	N.A.	< 0.1	< 0.1	< 0.1	N.A.	N.A.
Copper	mg/kg	0.32	0.33	0.29	0.31	0.38	0.39	0.27	0.35	0.23
Mercury	mg/kg	< 0.02	< 0.02	< 0.02	N.A.	< 0.02	< 0.02	< 0.02	N.A.	N.A.
Nickel	mg/kg	< 0.3	< 0.3	< 0.3	N.A.	< 0.3	< 0.3	< 0.3	N.A.	N.A.
Lead	mg/kg	< 0.06	< 0.06	< 0.06	N.A.	< 0.06	< 0.06	< 0.06	N.A.	N.A.
Zinc	mg/kg	0.96	0.91	0.81	0.89	1.44	1.23	0.83	1.17	0.21
Arsenic	mg/kg	< 0.09	< 0.09	< 0.09	N.A.	< 0.09	< 0.09	< 0.09	N.A.	N.A.

Comparison of the **heavy metal** content between CODEX and the result of the experimentation

			Maximum quantity in the experimentation of the tomato (1st season)		Maximum quantity in the experimentation of the tomato (2nd season)	
Articles	Target food	Standard (mg/kg)	Without Porous Alpha	With Porous Alpha	Without Porous Alpha	With Porous Alpha
Cadmium	Fruiting vegetables, other than cucurbits	0.05	< 0.01	< 0.01	< 0.02	< 0.02
Lead	Fruiting vegetables, other than cucurbits	0.1	0.06	0.04	< 0.06	< 0.06

Comparison of the **heavy metal** content between EU regulation and the result of the experimentation

			Maximum quantity in the experimentation of the tomato (1st season)		Maximum quantity in the experimentation of the tomato (2nd season)	
Articles	Target food	Standard (mg/kg)	Without Porous Alpha	With Porous Alpha	Without Porous Alpha	With Porous Alpha
Lead	Vegetables fruits other than sweet corn	0,05	0,06	0,04	< 0,06	< 0,06
Cadmium	Vegetables and fruit, excluding leaf vegetables, fresh herbs, fungi, stem vegetables, pine nuts, root vegetables and potatoes	0,05	< 0,01	< 0,01	< 0,02	< 0,02

7. Evaluation of environmental impact on fruit (Green bean / Flat bean)

In the experiment, the physicochemical characteristics and the presence of heavy metals in fruit are evaluated.

Results of **chemical analysis** on green bean for the 1st season (Analyzed by AGQ)

		Without Porous Alpha				With Porous Alpha				T-test
Article	Unit	100%	70%	50%	Average	100%	70%	50%	Avrage	p-value
Boron	mg/kg	< 5.00	< 5.00	< 5.00	NA	< 5.00	< 5.00	< 5.00	NA	NA
Calcium	%	0.5	0.5	0.46	0.49	0.44	0.47	0.52	0.48	0.73
Copper	mg/kg	<5.00	< 5.00	< 5.00	NA	< 5.00	< 5.00	< 5.00	NA	NA
Iron	mg/kg	110	115	87.9	104.30	91.6	125	88.1	101.57	0.86
Magnesium	%	0.4	0.41	0.4	0.40	0.38	0.4	0.44	0.41	0.86
Manganese	mg/kg	<5.00	< 5.00	< 5.00	NA	< 5.00	< 5.00	< 5.00	NA	NA
Molybdenum	mg/kg	<10.0	< 10.0	< 10.0	NA	< 10.0	< 10.0	< 10.0	NA	NA
Phosphorus	%	0.58	0.59	0.52	0.56	0.54	0.57	0.58	0.56	1.00
Potassium	%	2.87	2.99	2.56	2.81	2.85	3	2.91	2.92	0.45
Sodium	mg/kg	<250	< 250	< 250	NA	< 250	< 250	< 250	NA	NA
Sulfur	%	0.15	0.16	0.12	0.14	0.14	0.14	0.14	0.14	0.80
Zinc	mg/kg	5	< 5.00	< 5.00	5.00	< 5.00	< 5.00	< 5.00	NA	NA
Chlorine	mg/kg	2188	2731	2418	2446	2377	2357	3356	2697	0.53
Dumas nitrogen	%	3.62	3.76	3.36	3.58	3.62	3.6	4.12	3.78	0.39

Results of **chemical analysis** on flat bean for the 2nd season (Analyzed by Labomag)

		Without Porous Alpha				With Porous Alpha				T-test
Article	Unit	100%	70%	50%	Average	100%	70%	50%	Average	p-value
Boron	% DM	30.3	22.5	21.9	24.9	25.3	26.9	28.5	26.9	0.26
Calcium	% DM	0.74	0.63	0.59	0.65	0.87	0.59	0.63	0.70	0.68
Copper	mg/kg DM	6.23	5.76	6.13	6.04	6.44	6.12	6.06	6.21	0.42
Iron	mg/kg DM	31.2	31.79	31.27	31.42	31.85	32.32	31.53	31.90	0.18
Magnesium	% DM	0.57	0.55	0.48	0.53	0.56	0.53	0.55	0.55	0.67
Manganese	mg/kg DM	20.56	20.11	19.19	19.95	23.05	20.3	16.6	19.98	0.99
Phosphorus	% DM	0.42	0.44	0.44	0.43	0.43	0.45	0.41	0.43	0.81
Potassium	% DM	2.87	2.66	2.76	2.76	2.4	2.92	2.62	2.65	0.51
Sodium	mg/kg	159	123.68	316.99	199.89	118.54	185.56	142.89	149.00	0.46
Zinc	mg/kg DM	27.81	23.73	28.59	26.71	26.95	22.68	23.86	24.50	0.32
Chlorine	% DM	0.56	0.51	0.52	0.53	0.47	0.68	0.57	0.57	0.53
Nitrogen	% DM	2.86	2.96	2.62	2.81	2.63	2.78	2.94	2.78	0.83

Result of **heavy metal** contents in the fruit of green bean for 1st season (Analyzed by AGQ)

		Without Porous Alpha				With Porous Alpha				T-test
Article	Unit	100%	70%	50%	Average	100%	70%	50%	Average	p-value
Cadmium	mg/kg	< 0.01	< 0.01	< 0.01	NA	< 0.01	< 0.01	< 0.01	NA	NA
Chromium	mg/kg	< 0.10	< 0.10	< 0.10	NA	< 0.10	< 0.10	< 0.10	NA	NA
Copper	mg/kg	< 1.00	< 1.00	< 1.00	NA	< 1.00	< 1.00	< 1.00	NA	NA
Mercury	mg/kg	< 0.04	< 0.04	0.04	0.04	< 0.04	< 0.04	< 0.04	NA	NA
Nickel	mg/kg	< 0.05	0.06	0.09	0.08	0.1	0.08	0.05	0.08	0.94
Lead	mg/kg	0.07	0.11	0.06	0.08	0.1	< 0.01	0.12	0.11	0.25
Zinc	mg/kg	3.22	3.93	4.1	3.75	3.8	3.8	4.66	4.09	0.44

Result of **heavy metal** contents in the fruit of flat bean for 2nd season (Analyzed by Labomag)

		Without Porous Alpha				With Porous Alpha				T-test
Article	Unit	100%	70%	50%	Average	100%	70%	50%	Average	p-value
Cadmium	mg/kg	<0.02	<0.02	<0.02	N.A.	<0.02	<0.02	<0.02	N.A.	N.A.
Chromium	mg/kg	< 0.1	< 0.1	< 0.1	N.A.	< 0.1	< 0.1	< 0.1	N.A.	N.A.
Copper	mg/kg	1.06	0.97	0.98	1.00	1.08	0.83	0.81	0.91	0.17
Mercury	mg/kg	< 0.02	< 0.02	< 0.02	N.A.	< 0.02	< 0.02	< 0.02	N.A.	N.A.
Nickel	mg/kg	< 0.3	< 0.3	< 0.3	N.A.	< 0.3	< 0.3	< 0.3	N.A.	N.A.
Lead	mg/kg	< 0.06	< 0.06	< 0.06	N.A.	< 0.06	< 0.06	< 0.06	N.A.	N.A.
Zinc	mg/kg	5.38	3.75	4.7	4.61	5.99	3.91	3.84	4.58	0.97
Arsenic	mg/kg	< 0.09	< 0.09	< 0.09	N.A.	< 0.09	< 0.09	< 0.09	N.A.	N.A.

Comparison of the **heavy metal** content between <u>CODEX</u> and the result of the experimentation

			Maximum quantity in the experimentation of the green bean (1st season)		Maximum quantity in the experimentation of the flat bean (2nd season)	
Articles	Target food	Standard (mg/kg)	Without Porous Alpha	With Porous Alpha	Without Porous Alpha	With Porous Alpha
Cadmium	Legume vegetables	0.1	< 0.01	< 0.01	< 0.02	< 0.02
Lead	Legume vegetables	0.2	0.11	0.12	< 0.06	< 0.06

Comparison of the **heavy metal** content between <u>EU regulation</u> and the result of the experimentation

			Maximum quantity in the experimentation of the green bean (1st season)		Maximum quantity in the experimentation of the flat bean (2nd season)	
Articles	Target food	Standard (mg/kg)	Without Porous Alpha	With Porous Alpha	Without Porous Alpha	With Porous Alpha
Lead	Cereals and legumes	0.20	0.11	0.12	< 0.06	< 0.06
Cadmium	Vegetables and fruit, excluding leaf vegetables, fresh herbs, fungi, stem vegetables, pine nuts, root vegetables and potatoes	0.05	< 0.01	< 0.01	< 0.02	< 0.02

8. Evaluation of environmental impact on the soil

Result of chemical and heavy metal analysis on the soil for tomato production after 1st season (analysed by AGQ)

		Without Porous Alpha				With Porous Alpha				T-test
Article	Unit	100%	70%	50%	Average	100%	70%	50%	Average	p-value
Cadmium	mg/kg	0.37	0.24	0.33	0.31	0.34	0.48	0.4	0.41	0.09
Chromium	mg/kg	5.98	13.9	3.51	7.80	3.77	7.2	4.87	5.28	0.24
Copper	mg/kg	103	42	69.1	71.37	61.6	67.4	89.8	72.93	0.47
Mercury	mg/kg	< 0.10	< 0.10	0.12	0.12	< 0.10	< 0.10	< 0.10	N.A.	N.A.
Nickel	mg/kg	4.19	24.8	3.56	10.85	4.08	6.48	4.34	4.97	0.24
Lead	mg/kg	40.1	13	43.7	32.27	52.6	44.7	47.5	48.27	0.09
Zinc	mg/kg	54	26.9	58.9	46.60	69.2	55.5	66.4	63.70	0.09
Exchangeable Calcium	meq /100 g	7.67	7.34	6.94	7.32	7.5	6.91	6.91	7.11	0.25
cation exchange capacity (EC 1C0)	meq /100 g	11.4	10.1	9.74	10.41	10.1	9.14	10.4	9.88	0.22
Exchangeable magnesium	meq /100 g	2.29	1.79	1.85	1.98	1.72	1.58	1.7	1.67	0.07
Exchangeable potassium	meq /100 g	0.17	0.15	0.15	0.16	0.28	0.19	0.2	0.22	0.04*
Exchangeable Sodium	meq /100 g	< 0.05	< 0.05	< 0.05	N.A.	< 0.05	< 0.05	< 0.05	N.A.	N.A.
Active limestone	% $CaCO_3$	1.84	2.73	2.48	2.35	2.49	1.99	2.69	2.39	0.46
Available Calcium	meq /100 g	7.91	8.06	7.85	7.94	8.03	7.65	7.97	7.88	0.35
Electrical conductivity	µS/cm à 20ºC	184	199	194	192.33	190	201	185	192.00	0.48
Available magnesium	meq /100 g	2.85	2.39	2.52	2.59	2.25	2.12	2.41	2.26	0.06
Oxidizable Organic Matter	%	1.36	0.85	0.97	1.06	1.36	0.89	0.99	1.08	0.46
Dumas Nitrogen	mg/kg	892	598	726	738.67	752	571	769	697.33	0.36
pH (extract 1/2.5)	-	8.85	8.9	8.85	8.87	8.6	8.96	9.1	8.89	0.45
Available Phosphore	mg/kg	258	114	137	169.67	229	165	126	173.33	0.47
Available Potassium	meq /100 g	0.21	0.2	0.19	0.20	0.42	0.28	0.29	0.33	0.0499*
Available Sodium	meq /100 g	0.22	0.28	0.22	0.24	0.12	0.22	0.22	0.19	0.12
Boron	mg/kg	< 0.50	< 0.50	< 0.50	N.A.	< 0.50	< 0.50	< 0.50	N.A.	N.A.
Copper	mg/kg	< 2.50	< 2.50	< 2.50	N.A.	< 2.50	< 2.50	< 2.50	N.A.	N.A.
Iron	mg/kg	10	6.84	9.81	8.88	10.1	0	10.5	10.30	0.30
Manganese	mg/kg	67.6	51.9	53.2	57.57	57.9	47	56.1	53.67	0.28
Zinc	mg/kg	22.2	9.19	11.9	14.43	20.8	11.1	9.49	13.80	0.46
Relation C/N	-	8.85	8.22	7.76	8.28	10.5	9.04	7.46	9.00	0.24

** Regarding the exchangeable potassium and available potassium, the content in the soil with Porous Alpha was higher than without Porous Alpha even before starting the experimentation.*

Comparison of heavy metal limits in the soil according to the Council Directive of 12 June 1986 on the protection of the environment including soil when the use of sewage sludge in agriculture (86/278 / EEC) and the experimental results

	Maximum values limits defined in the Directive(mg /kg)	Without Porous Alpha	With Porous Alpha
Cadmium	3	0.37	0.48
Copper	140	103	89.8
Nickel	75	24.8	6.48
Lead	300	43.7	52.6
Zinc	300	58.9	69.2
Mercury	1.5	0.12	< 0.10
Chromium	-	13.9	7.2