

AREI greenhouse trial — lettuce and peas

Greenhouse observations in lettuce and peas, including product rates and measured biomass comparisons.

Full text and tables in the selected language. Automatic translation with terminology and numerical checks; not a certified translation. Author statements, including disputed claims, are retained. Editorial notes are separate.

Editorial note

Observed differences are crop- and protocol-specific; formal statistical support and harvest-yield interpretation are limited. The source gives protein values of 138–144%. These cannot represent a mass fraction; the intended basis or a source error needs clarification. They are preserved as author text, not a verified product benefit.

[NanoImport — Editorial note ↗](#)

APP “Institute of Agricultural Resources and Economics”

STENDE RESEARCH CENTRE

„Evaluation of the efficacy of ChitoHumus in the covered areas of lettuce and pea pot trials”

Researchers:

MSc in Agriculture, Solveiga Maļeckā,

Research assistant Margita Damškalne

APP “Institute of Agricultural Resources and Economics”

Stende Research Centre

Dižstende, 2025

The purpose of the trial:

To compare the effects of bioproduct doses on lettuce and pea green mass and its quality in greenhouse conditions.

Test methodology and conditions

Table 1

Test site	Stende Research Centre, Institute of Agricultural Resources and Economics, "Dižzemes", Dižstende, LV-3258	Stende Research Centre, Institute of Agricultural Resources and Economics, "Dižzemes", Dižstende, LV-3258
Commissioning client	SIA JIKO Ent	SIA JIKO Ent
Trial started	2025.g.	2025.g.
Trial finished	2025.g.	2025.g.
Name of the trial	Evaluation of the efficacy of ChitoHumus in the areas covered in the lettuce and pea pot trial.	Evaluation of the efficacy of ChitoHumus in the areas covered in the lettuce and pea pot trial.
Trial environment	Greenhouse	Greenhouse
Growing method	Pots	Pots
Series 1	Series 1	Series 1
Crop	Lettuce (Lettuce)	Peas (Pisum sativum)
Variety	'Lollo Bionda'	'Casablanca'
Type of substrate	Peat substrate KKS , neutralized peat finely sifted, fraction, mm:0-7mm, moisture max. 60%, peat decomposition degree according to von Post scale: H2-H5, SIA Laflora, Kaigu peat bog, guaranteed volumetric density of substrate 140-180 kg m3, 250L	Peat substrate KKS , neutralized peat finely sifted, fraction, mm:0-7mm, moisture max. 60%, peat decomposition degree according to von Post scale: H2-H5, SIA Laflora, Kaigu peat bog, guaranteed volumetric density of substrate 140-180 kg m3, 250L
Characteristics of the substrate	pHKCl 5.1-6.1 EC (mS/cm: 0.10. Calcium, Ca: 1.16%; Magnesium, Mg: 0.07%.)	pHKCl 5.1-6.1 EC (mS/cm: 0.10. Calcium, Ca: 1.16%; Magnesium, Mg: 0.07%.)
Date of sowing/planting	August 7	August 7
Sizes of pots	1.47 L pots	5.7 L pot
Type of planting / sowing	1 piece in a pot	6 peas in a pot
Added to the substrate	substrate	sand 0.5 : 4 substrate
Added to the substrate	complex fertilizer + trace elements YaraMila Cropcare N:P:K(S) 11-11-21 (26), Mg, B, Cu, Mn 100g on 4 buckets of peat	complex fertilizer + trace elements YaraMila Cropcare N:P:K(S) 11-11-21 (26), Mg, B, Cu, Mn 100g on 4 buckets of peat
Added to the substrate	No added wetting agent	No added wetting agent
Treatment	Control without NPK; ChitoHumus 0.1 L ha-1 without NPK (C1); ChitoHumus 0.2 L ha-1 without NPK (C2); control with NPK; ChitoHumus 0.1 L ha-1 with NPK (C1); ChitoHumus 0.2 L ha-1 with NPK (C2)	Control without NPK; ChitoHumus 0.1 L ha-1 without NPK (C1); ChitoHumus 0.2 L ha-1 without NPK (C2); control with NPK; ChitoHumus 0.1 L ha-1 with NPK (C1); ChitoHumus 0.2 L ha-1 with NPK (C2)
Harvesting	Fresh biomass at market maturity	Fresh biomass at the start of flowering
	6.09.2025.	26.-27.09.2025.

Observations and accounting for harvest	Fresh biomass, g (weighed on OHAVS Scout laboratory scales: 620 g, d = 0.01 g). Dry matter, % (Cabinet Regulation No. 518). Leaf length, cm. Number of leaves, pcs. Root collar diameter, mm (with calipers). Root length, cm (difficult to wash out of peat; some parts break off). Leaf quality: protein in dry matter, % (elemental analysis, dry combustion); crude fibre in dry matter, % (insufficient material from unfertilised plants) (ISO 5498:1981); potassium in dry matter, % (LVS EN ISO 6869:2002); calcium in dry matter, % (GOST 26570-95); magnesium in dry matter, % (GOST 26570-95).	Plant green mass, g (weighed on laboratory scales OHAVS Scout (620 g, d= 0.01g) Dry matter, % (Ministry of the Interior Regulation No.518) Root length, cm Green mass quality: protein in dry matter, % (Element analysis, dry combustion); crude fibre in dry matter, % (ISO 5498:1981); potassium in dry matter, %, (LVS EN ISO 6869:2002); phosphorus in dry matter, g kg-1 (ISO 6491:1998); NDF dry, % (LVS EN ISO 16472:2006); ADF dry, % (ISO 13906 : 2008)
Test reports	TN-103/25, 07.10.25	TN-125/25, 08.10.25.
Area to be counted	10 plants per treatment	60 plants per treatment
Number of variants	6	6
Number of replicates	10	10
Total number of variants	12	12
Total number of pots	120	120
The watering mode	As needed	As needed
Series 2	Series 2	Series 2
Crop	Peas (Pisum sativum)	Peas (Pisum sativum)
Variety	‘Salamanca’	‘Salamanca’
Date of sowing/planting	14 October	14 October
Soil	field soil	field soil
Sizes of pots	1.47 L pots	1.47 L pots
Type of planting / sowing	1 pea in a pot	1 pea in a pot
Soil characteristics	pH 5.81, org.v. 2.03%, movable phosphorus 355.2 mg kg-1, movable potassium 236.5 mg kg-1, total nitrogen 0.81 mg g-1	pH 5.81, org.v. 2.03%, movable phosphorus 355.2 mg kg-1, movable potassium 236.5 mg kg-1, total nitrogen 0.81 mg g-1
Nitrogen fertilizer	YaraBela Axan N27-S4, applied at a dose of N30 kg ha-1	YaraBela Axan N27-S4, applied at a dose of N30 kg ha-1
	Control without NPK; ChitoHumus 0.1 L ha-1 without NPK; ChitoHumus 0.2 L ha-1 without NPK; ChitoHumus 0.1 L ha-1 with NPK; ChitoHumus 0.2 L ha-1 with NPK	Control without NPK; ChitoHumus 0.1 L ha-1 without NPK; ChitoHumus 0.2 L ha-1 without NPK; ChitoHumus 0.1 L ha-1 with NPK; ChitoHumus 0.2 L ha-1 with NPK
Harvesting	Fresh biomass at the start of flowering	Fresh biomass at the start of flowering
	25.11.2025.	25.11.2025.

Observations and accounting for harvest	Plant fresh biomass, g (weighed on OHAVS Scout laboratory scales: 620 g, d = 0.01 g). Dry matter in aboveground parts, % (Cabinet Regulation No. 518). Plant length, cm. Root mass, g (weighed on OHAVS Scout laboratory scales: 620 g, d = 0.01 g). Root dry matter, % (Cabinet Regulation No. 518). Root length, cm. Number of tendrils, pcs.	Plant fresh biomass, g (weighed on OHAVS Scout laboratory scales: 620 g, d = 0.01 g). Dry matter in aboveground parts, % (Cabinet Regulation No. 518). Plant length, cm. Root mass, g (weighed on OHAVS Scout laboratory scales: 620 g, d = 0.01 g). Root dry matter, % (Cabinet Regulation No. 518). Root length, cm. Number of tendrils, pcs.
Test reports	TA-59/25, 23.10.2025; TN-166/25, 28.11.25.; TN-167/25, 28.11.25.	TA-59/25, 23.10.2025; TN-166/25, 28.11.25.; TN-167/25, 28.11.25.
Area to be counted	4 plants per treatment (series 2)	4 plants per treatment (series 2)
Number of variants	5	5
Number of replicates	4	4
Total number of variants	5	5
Total number of pots	20	20
The watering mode	As needed	As needed
Data processing	Using Microsoft Excel	Using Microsoft Excel
Special requirements	-	-

Biological product treatments: lettuce

Table 2			
Treatment	1., 4.	2., 5.	3., 6.
Product	Untreated	Biological product	Biological product
Name	-	ChitoHumus	ChitoHumus
Dose, L ha-1	-	0.1	0.2
Time of use	-	22.08.2025. 29.08.2025.	22.08.2025. 29.08.2025.
Method of processing	-	spraying	spraying
Water consumption, L ha-1	-	200	200
Equipment	-	Hand sprayer	Hand sprayer

Biological product treatments: peas

Table 3			
Treatment	1., 4	2., 5.	3., 6.
Product	Untreated	Biological product	Biological product
Name	-	ChitoHumus	ChitoHumus
Dose, L ha-1	-	0.1	0.2
Time of use	-	Series 1 22.08.2025. 13-14 AE 29.08.2025. 06.09.2025.	Series 1 22.08.2025. 13-14 AE 29.08.2025. 06.09.2025.

Treatment	1.	2., 5.	3., 6.
		Series 2 01.11.2025. 13-14 AE 07.11.2025.	Series 2 01.11.2025. 13-14 AE 07.11.2025.
Method of processing	-	spraying	spraying
Water consumption, L ha-1	-	200	200
Equipment	-	Hand sprayer	Hand sprayer

Results

Lettuce

Variety characteristics - medium-early variety forms thick, pronouncedly curly bright green leaves. Weight of the head 300 g. For early harvest in greenhouses, 20-30-day-old seedlings are exhibited at a distance of 20-25 cm. In open ground sown in May, June 0.5-1 cm depth, the spacing between plants 10-12 cm. Grows in 53-60 days. After ingestion, it regrowth. Plants high frost resistance - to -5oC. Variety resistant to bloom. Not bitter. Not demanding to heat, likes light. Lettuce leaves contain proteins, carbohydrates, minerals, various vitamins.

Lettuce in unfertilized variants after planting grew very slowly and did not form green mass, it was 1-2% of the green mass of fertilized variants. Two times ChitoHumus was applied (C1 and C2) at doses - 0.1 l ha-1 and 0.2 l ha-1, harvested at market maturity in fertilized version, but unfertilized were undeveloped and weight negligible.

Table

Lettuce green and dry, Stendes PC, 2025.

Table 4						
Designation of the variant	Green mass per plant, g	against K, %	Dry matter of one plant, % (Cabinet Regulation No. 518)	% of K	Length of the leaf, cm	Number of leaves, pcs.
K	1.17		13.19		4.4	5
C1	1.35	115.0	14.12	107.1	4.6	5
C2	1.36	116.1	13.19	100.0	4.5	5
NPK	70.21		5.45		18.5	12
NPK C1	65.07	92.7	5.24	96.3	18.1	12
NPK C2	77.41	110.3	5.01	92.0	20.5	13

The number of pages did not differ significantly in the variants. The leaf length only in the variant - NPK C2 was 2 cm longer lettuce. Green mass was also higher by 10.3% in the variant - NPK C2 compared to the control. Dry higher was under control.

The roots were difficult to wash out in the peat substrate, so some of the roots may have broken and the mass cannot be objectively determined due to peat particles that are tightly attached to the roots. Therefore, the determined root length is not accurate (biased). The root collar diameter was equivalent in all fertilized varieties.

The quality of lettuce. The protein content in the fertilized varieties was 138-144%. In the unfertilized ones, crude fibres could not be determined because the dry matter was insufficient. The amount of wood fibre in the fertilized was equivalent in the variants. Potassium and magnesium were more in the fertilized variants, and calcium in the unfertilized variants.

For an objective evaluation of the bioproduct, the trial must be repeated, because single results give an incomplete picture of the effects of the investigated products.

Table

Lettuce roots characteristics, Stendes PC, 2025.

Table 5				
Designation of the variant	Root collar diameter, mm	% of K	Root length, cm*	% of K
K	0.22		12.8	
C1	0.21	95.5	11.6	90.6
C2	0.21	95.5	14.65	114.5
NPK	1.04		20.8	
NPK C1	0.99	95.2	18.15	87.3
NPK C2	0.96	92.3	20.65	99.3

*peat is difficult to wash out, so some of the roots may have broken and the mass cannot be determined objectively due to peat particles.

Table

Lettuce quality, Stendes PC, 2025.

Table 6						
Designation of the variant	Protein in dry matter, % (Element analysis, dry combustion)	% of K	Crude fibre in dry matter, % (ISO 5498:1981)	Potassium in dry matter, % (LVS EN ISO 6869:2002)	Calcium in dry matter, % (GOST 26570-95)	Magnesium in dry matter, % (GOST 26570-95)
K	15.74		Not available	3.42	1.32	0.23
C1	14.93	94.9	Not available	2.98	1.32	0.3
C2	16.12	102.4	Not available	3.21	1.28	0.31
NPK	37.39		12.79	7.70	0.52	0.68
NPK C1	39.59	105.9	12.57	7.27	0.45	0.74

NPK C2	36.64	98.0	12.96	7.92	0.6	0.79
--------	-------	------	-------	------	-----	------

Peas - 1st series

Peas 'Casablanca' is a yellow pea variety with good yields and high protein content in the seeds. It has been grown in Latvia for several years, obtaining stable harvests. Forms medium-high plants with good stem stability. Representative of breeder rights: KWS Lochow GmbH.

ChitoHumus (C1 and C2) at doses of 0.1 l ha⁻¹ and 0.2 l ha⁻¹, applied 3 times during growth.

The green mass was harvested at the beginning of flowering, because due to high humidity there was a strong spread of mildew and further cultivation would not be productive. The mass of the fertilized varieties was about 4 times higher than that of the unfertilized ones. The use of ChitoHumus (C1) provided 9.7% green mass increase and ChitoHumus (C2) 33.9% green mass increase.

The roots were difficult to wash out in the peat substrate, so some of the roots may have broken and the mass cannot be objectively determined due to peat particles that are tightly attached to the roots. Therefore, the determined root length data were subjective.

Protein, potassium and phosphorus contents in the unfertilized varieties were increased with ChitoHumus, while in the fertilized varieties they were reduced. Crude fibre content on the contrary. Minimum criterion for quality feed > 14% dry matter.

For an objective evaluation of the bioproduct, the trial must be repeated, because single results give an incomplete picture of the effects of the investigated products.

ADF (associated with the structural components of the plant, in particular the cell walls) and NDF determine digestibility - the quality of peas as feed. Low NDF values are generally desirable as the NDF value increases as the feed ripens.

Table 2.1

Peas green and dry, Stendes PC, 2025.

Table 7								
Designation of the variant	Green mass of plant from pot, g	% of K	Avg. green mass per plant, g	% of K	Average root length, cm *	% of K	Aboveground dry matter, % (Cabinet Regulation No.518)	% of K
K	18.85		3.28		34.7		25.91	
C1	19.83	105.2	5.54	169.0	34.4	99.2	25.13	97.0
C2	18.57	98.5	3.10	94.7	35.9	103.6	24.51	94.6
NPK	76.55		13.86		33.6		19.82	
NPK C1	83.95	109.7	23.99	173.2	31.6	94.2	16.70	84.2
NPK C2	102.51	133.9	31.08	224.3	32.1	95.5	14.52	73.3

*peat is difficult to wash out, so some of the roots may have broken and the mass cannot be determined objectively due to peat particles.

Table 2.2

Pea dry quality, Stendes PC, 2025.

Table 8						
Designation of the variant	Protein in dry matter, % (Element analysis, dry combustion)	% of K	Crude fibre in dry matter, % (ISO 5498:1981)	% of K	Potassium in dry matter, % (LVS EN ISO 6869:2002)	Phosphorus in dry matter, g/kg (ISO 6491:1998)
K	17.82		30.99		1.97	1.59
C1	25.04	140.5	22.95	74.1	4.60	6.73
C2	22.22	124.7	24.44	78.9	4.28	5.98
NPK	22.81		26.10		4.35	6.67
NPK C1	17.61	77.2	29.93	114.7	1.97	1.54
NPK C2	18.60	81.5	30.36	116.3	2.08	1.51

Table 2.3

Table 9				
Designation of the variant	NDF dry, % (LVS EN ISO 16472:2006)	% of K	ADF dry, % (ISO 13906 : 2008)	% of K
K	46.33		41.41	
C1	38.41	82.9	31.40	75.8
C2	39.25	84.7	35.66	86.1
NPK	42.20		35.35	
NPK C1	47.45	112.4	43.37	122.7
NPK C2	46.18	109.4	39.70	112.3

Peas — series 2

Pea variety ‘Salamanca’ is a high yield potential, early, protein pea variety, with good resistance to diseases, easy to pluck, high to very high resistance to mildew. Country of origin Germany, breeder representative Saaten-Union GmbH, quality group – food.

ChitoHumus (C1) and (C2) were applied twice and the peas were grown in soil harvested from the seed crop succession field No. ICC 1, the results of the analysis reflected in the methodology. For comparison, nitrogen fertilizer was used in two variants - dose N30 kg ha-1.

Table

Peas green and dry, Stendes PC, 2025.

Table 10

Designation of the variant	Green mass per plant, g	% of K	Dry matter, %	Plant height, cm	% of K	Number of tendrils, pcs.
K	10.33		18.14	58.0		15
C1	12.48	120.8	18.32	68.8	118.5	16
C2	12.24	118.5	21.3	68.6	118.3	16
N C1	13.10	126.8	19.51	66.7	115.0	17
N C2	13.18	127.6	16.84	67.6	116.5	16

Table

Pea root mass, length length and dry, Stendes PC, 2025.

Table 11

Designation of the variant	Root length, cm	% of K	Root mass, g	% of K	Dry matter, %
K	22.95		7.68		10.64
C1	23.78	103.6	8.15	106.1	11.24
C2	26.03	113.4	9.27	120.8	11.79
N C1	22.88	99.7	9.20	119.9	13.35
N C2	27.68	120.6	11.06	144.0	16.32

The green mass in the treated varieties was 18.8-27.6% higher than in the control. Plant length in the treated varieties was also 15-18.5% longer than in the control, so the peas had one string more. The soil separates from the roots more easily than peat substrate, so it was possible to determine the root mass and it was 6.1-44% higher in the treated variants compared to the control. Root length is also more objective and was 3.4-3.6% without fertilizer, but with fertilizer was equivalent or 20.6% greater.

Person responsible for the tests

Solveiga Maļeckā

09.01.2026.