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ECONOMIC AND ENERGY EFFICIENCY OF GROWING VEGETABLE PEAS

Abstract.

In addition to agronomic importance, as one of the best predecessors, peas provide significant economic efficiency. The constant rise in prices for mineral fertilizers, plant protection products, fuel, etc. leads to increased costs of cultivation and reduced profits from the sale of peas. Therefore, it is predominant not only to achieve a high level of yield but also to improve economic efficiency. Given that the control variant used mineral fertilizers in the norm $N_{30}P_{60}K_{60}$ and pre-sowing treatment of seeds with an inoculant, the lion's share of costs compared to other variants is the background of the control variant, which has been essentially superimposing on added variants. However, the low profitability of the control option is the cause of high costs for mineral fertilizers, and a small gradual increase in yield due to seed treatment with trace elements, soil liming, foliar fertilization is quite understandable in increasing the profitability of growing peas. The most important indicator of economic efficiency is profit. The economic efficiency of growing vegetable peas has been characterizing by positive results in all variants of the experiment. This indicator was the lowest in the control (7553-8601 and 11989-12630 UAH / ha), it was higher in the second, as well as the third and fourth versions of the research (8596-9644 and 13020-13673 UAH / ha); 14399 UAH / ha); (10548-11517 and 14814-15862 UAH / ha). That is, with the increase in the level of yield due to the intensification of the technology of growing crops, the profit of the extension products gradually increases. Reaching its maximum in the fourth version of the study, due to the synergistic interaction of nutrients, the return on fertilizers increases. The high yield of vegetable peas, which accumulated the highest energy values - 12.55 and 14.87 million kcal - provided a high coefficient of energy efficiency in our research, which was 3.36 in Skinado and 3.99 in Somerwood.

Keywords*: lime rate, vegetative mass, control variant, vegetable peas*

Introduction. Vegetable peas are an important protein crop. It contains 20-22% dry matter, 6-7% protein, 5-7% sugars, 2-4% starch. According to the protein, it occupies a leading position among vegetable crops. The biological value of protein has been determining by its easy digestibility by the human body, the composition of essential amino acids: lysine (1.52 m%), tryptophan (0.25%), threonine (0.84%), and others.

Through their research, scientists confirm that it is very chief for plants to provide them with trace elements and biologically active substances that come to them together with micro fertilizers and plant growth regulators, which are now an integral part of modern technologies for growing crops, especially with the introduction of new high-yielding vegetable pea varieties that require a balanced diet.

In addition to agronomic importance, as one of the best predecessors, peas provide significant economic efficiency. The constant rise in prices for mineral fertilizers, plant protection products, fuel, etc. leads to increased costs of cultivation and reduced profits from the sale of peas. Therefore, it is foremost not only to achieve a high level of yield but also to improve economic efficiency. The profitability of growing peas is 42.5-74.6%.

Research methods.

The scheme of the experiment included the study of the following options: Factor A – varieties: 1. Skinado – control. 2. Somerwood; Factor B – liming: 1. Without liming; 2. 0.5 norms of lime per year; 3. 1,0 norms of lime on g. K. Factor C – Feeding: 1. $N_{30}P_{60}K_{60}$ + Inoculation (background) – control; 2. Background + Wuxal Extra CoMo (1 l / t of seeds); 3. Background + Wuxal Extra CoMo (1 l / t of seeds) + Wuxal Microplant during the growth of vegetative mass – 1.5 l / ha; 4. Background + Wuxal Extra CoMo (1 l / t of seeds) + Wuxal Microplant during vegetative mass growth – 1.5 l / ha + Wuxal Calcium, Boron (budding phase) – 1.5 l / ha.

The field experiment has been accompanying by phenological observations. The dates of onset and passage of phenophases have been recording: seedlings, budding, flowering, technical maturity.

An economic evaluation of the effectiveness of the elements of cultivation technology was calculated based on technological maps based on actual prices in 2019 according to the generally accepted method, taking into account costs per 1 ha, profit per 1 ha, cost, and profitability.

Calculations of energy efficiency were performed according to the method of OK Medvedovsky and P.I. Ivanenko.

Results. The cost of the grown production depending on variants of researches varied from 18091 to 23463 UAH. in the Skinado variety and from UAH 2,436 to UAH 27,808 in the Somerwood variety, depending on the applied cultivation methods and varietal characteristics (Tables 1, 2).

Table 1.

Indicators of economic efficiency of growing the vegetable pea variety Skinado depending on liming and foliar fertilization, the average of 2017-2019.

Foliar feeding factor C	Liming factor B	Crop capacity, t / ha	Cost products from 1 hectare, UAH	Costs per 1 ha, UAH	The cost of 1 ton grain, UAH	Profit, UAH / ha	Profitability level,%
1. $N_{30}P_{60}K_{60}$ + Inoculation (background) - control.	Without liming	2,29	18091	10538	4061,7	7553	71,7
	0.5 norms of lime for g. K.	2,38	18802	10646	4473,1	8156	76,6
	1.0 norms of lime for g. K.	2,45	19355	10754	4389,4	8601	80,0
2. Background + Wuxal Extra CoMo	Without liming	2,46	19434	10838	4405,7	8596	79,3
	0.5 norms of lime for g. K.	2,54	20066	10946	4309,4	9120	83,3
	1.0 norms of lime for g. K.	2,62	20698	11054	4219,1	9644	87,2
3. Background + Wuxal Extra CoMo + Wuxal Microplant	Without liming	2,66	21014	11218	4217,3	9796	87,3
	0.5 norms of lime for g. K.	2,75	21725	11326	4118,5	10399	91,8
	1.0 norms of lime for g. K.	2,81	22199	11434	4069,0	10765	94,1
4. Background + Wuxal Extra CoMo + Wuxal Microplant + Wuxal Calcium, Boron	Without liming	2,82	22278	11730	4159,6	10548	89,9
	0.5 norms of lime for g. K.	2,91	22989	11838	4068,0	11151	94,2
	1.0 norms of lime for g. K.	2,97	23463	11946	4022,2	11517	96,4

Given that the control variant used mineral fertilizers in the norm $N_{30}P_{60}K_{60}$ and pre-sowing treatment of seeds with an inoculant, the lion's share of costs compared to other variants is the background of the control variant, which has been essentially superimposing on additional variants. However, the low profitability of the control option is the cause of high costs for mineral fertilizers. A small gradual increase in yield due to seed treatment with trace elements, soil liming, foliar fertilization is quite understandable in increasing the profitability of growing peas. The highest indicators of economic efficiency have been obtaining on the variant of the experiment, where it has been applying against the background of the control variant of soil liming (1.0 norms per hectare), pre-sowing seed treatment with micro fertilizer Wuxal Extra CoMo, foliar fertilization Wuxal Microplant and Wuxal Calcium, Boron in both varieties vegetable peas.

Table 2.

Indicators of economic efficiency of growing Somerwood vegetable peas depending on liming and foliar fertilization, average 2017-2019

Foliar feeding factor C	Liming factor B	Crop capacity, t / ha	Cost products from 1 hectare, UAH	Costs per 1 ha, UAH	The cost of 1 ton grain, UAH	Profit, UAH / ha	Profitability level,%
1. $N_{30}P_{60}K_{60}$ + Inoculation (background) - control.	Without liming	2,84	22436	10538	3710,6	11898	112,9
	0.5 norms of lime for g. K.	2,91	22989	10646	3658,4	12343	115,9
	1.0 norms of lime for g. K.	2,96	23384	10754	3633,1	12630	117,4
2. Background + Wuxal Extra CoMo	Without liming	3,02	23858	10838	3588,7	13020	120,1
	0.5 norms of lime for g. K.	3,07	24253	10946	3565,4	13307	121,6
	1.0 norms of lime for g. K.	3,13	24727	11054	3531,6	13673	123,7
3. Background + Wuxal Extra CoMo + Wuxal Microplant	Without liming	3,16	24964	11218	3550	13746	122,5
	0.5 norms of lime for g. K.	3,21	25359	11326	3528,3	14033	123,9
	1.0 norms of lime for g. K.	3,27	25833	11434	3496,6	14399	125,9
4. Background + Wuxal Extra CoMo + Wuxal Microplant + Wuxal Calcium, Boron	Without liming	3,36	26544	11730	3491,1	14814	126,3
	0.5 norms of lime for g. K.	3,45	27255	11838	3431,3	15417	130,2
	1.0 norms of lime for g. K.	3,52	27808	11946	3393,8	15862	132,8

At the same time, the cost of production varied from 23,463 in the Skinado variety to 27,808 UAH / ha in the Somerwood variety, despite the overpriced of growing products – 11,946 UAH / ha, the maximum profit – 11,517 and 15,862 UAH / ha and the highest level of profitability – 96.4 and 132.8% (Figs. 1, 2) and the lowest cost of cultivation in our studies.

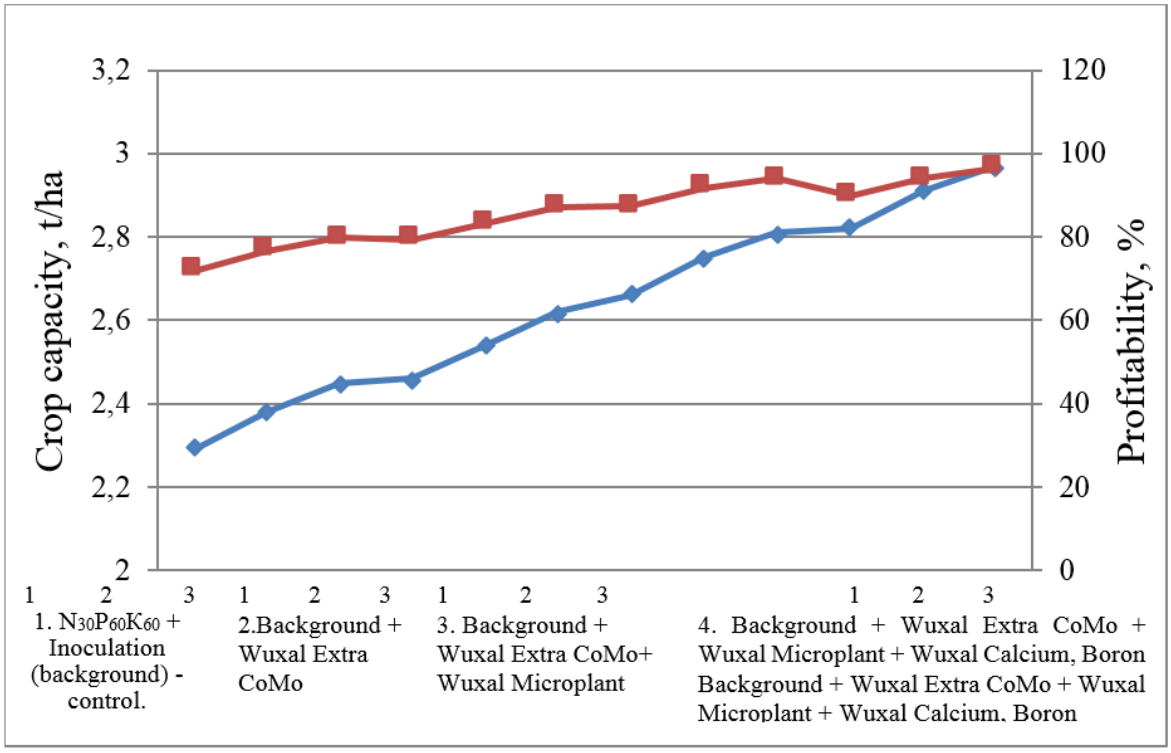

Fig. 1 Profitability level and yield of Skinado pea variety depending on liming and foliar feeding
Note: 1 - without liming; 2 - 0.5 norms per year; 3 - 1.0 norms for g. K.

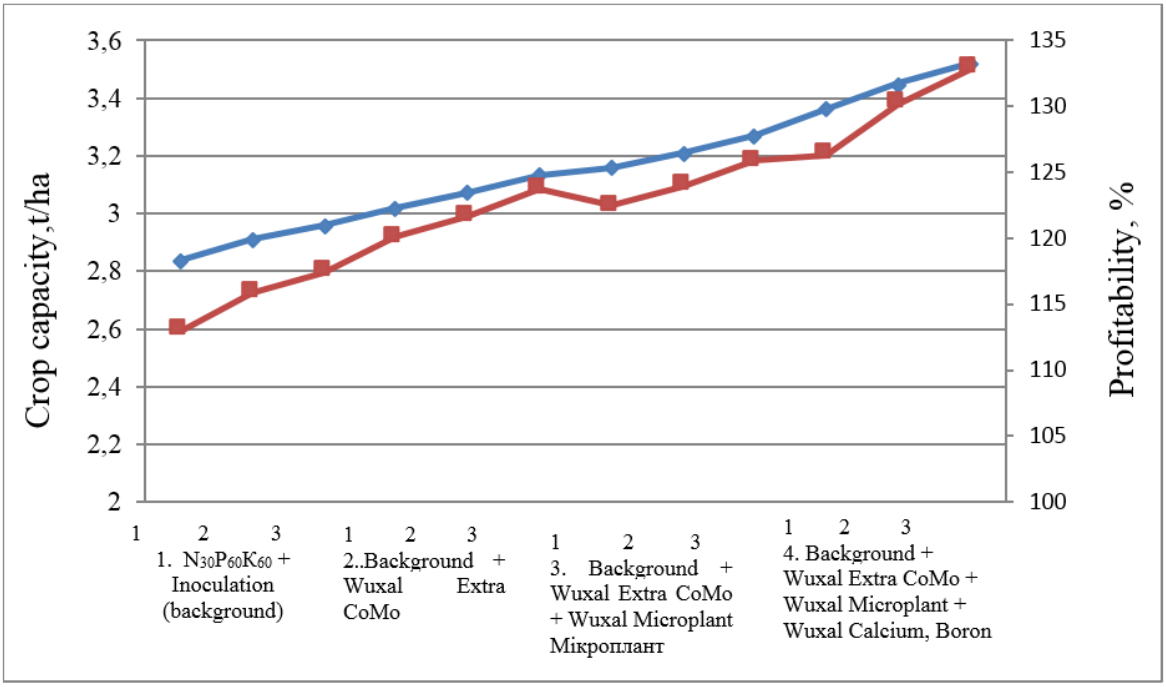

Fig. 2 Level of profitability and yield of Somerwood pea variety depending on liming and foliar fertilization of products – 4022.2 and 3393.8 UAH / ha.
Note 1 - without liming; 2 - 0.5 norms per year; 3 - 1.0 norms for g. k.

No damage has been observing in any of the variants of the experiment. Analyzing the cost of production for each of the research options, it should have been noting that the increase in yield obtained from soil liming, pre-sowing treatment of seeds with micro fertilizers, and foliar fertilization with micro fertilizers has been reflecting in the gradual increase in profits. The aforementioned determines the payback of additional

costs for growing products, given the low cost of activities. Thus, the lowest costs for growing products have been obtaining in the first version of the experiment from 10538 to 10754 UAH / ha. The increase in production costs was observed in the second variant of the experiment from 10838 to 11054 UAH / ha, as well as in the third and fourth variant of the experiments from 11218 to 11434 and from 11730 to 11946 UAH / ha.

The cost analysis shows that the lowest cost of 1 ton of grain (4022.2 and 3393.8 UAH) has been observing in the fourth version of the experiment, where soil liming has been carrying out (1.0 norms per hectare). Which is associated with the highest yield of vegetable peas. The highest (4069.0 and 3496.6; 4219.1 and 3531.6; 4389.4 and 3633.1 UAH) was the third, second and first version of the experiment, where soil liming with the maximum rate of lime has been carrying out. The aforementioned is due to lower yields.

The most important indicator of economic efficiency is profit. The economic efficiency of growing vegetable peas has been characterizing by positive results in all variants of the experiment. This indicator was the lowest in the control (7553-8601 and 11989-12630 UAH / ha), it was higher in the second, as well as the third and fourth versions of the research (8596-9644 and 13020-13673 UAH / ha); 14399 UAH / ha); (10548-11517 and 14814-15862 UAH / ha). That is, with the increase in the level of yield due to the intensification of the technology of growing crops, the profit of the expended products gradually increases. Reaching its maximum in the fourth version of the study, due to the synergistic interaction of nutrients, the return on dressing increases. Thus, against the background of control of pre-sowing seed treatment Wuxal Extra CoMo, foliar fertilization Wuxal Microplant, and Wuxal Calcium Bor, the profit compared to the power of maximum soil liming increased by 2916 and 3232 UAH / ha.

Thus, due to the optimization of the micronutrient nutrition system, synergistic interaction of fertilizers, the profit increased from 8601 and 12630 to 11517 and 15862 UAH / ha at the maximum liming of the soil (1.0 n.v. per year).

Carrying out energy analysis after generalization of experimental data of field experiment allows establishing energy efficiency of the agricultural production process as the dominant factor of reproduction of agricultural production taking into account features of agriculture at the existing level of development of technologies and equipment. The use of general energy methods for assessing the processes of crop production allows justifying the technology of cultivation in terms of optimizing the energy balance of agroecosystems.

The cost analysis shows that the lowest cost of 1 ton of grain (4022.2 and 3393.8 UAH) has been observing in the fourth version of the experiment, where soil liming has been carrying out (1.0 norms per hectare).

In determining this balance should take into account the peculiarities of crop production – the presence of renewable (solar energy, soil fertility, and energy potential, air and soil temperature, rainfall) and non-renewable (vitality concentrated in mineral and organic fertilizers, pesticides, the energy contained in technical means and equipment, the energy of living labor, etc.).

Given the constant fluctuations in the price of crop products, fertilizers, pesticides, biologicals, PPPs, and other resources, energy assessment of the developed elements of pea cultivation technology is principal with the establishment of indicators of energy consumption in agricultural production with its comparison to energy growth accumulated by crops. (Table 3, Table 4).

Table 3.

The energy efficiency of growing Skinado vegetable peas depending on liming and foliar fertilization, average 2017-2019

Foliar feeding factor C	Liming factor B	The energy intensity of the crop from 1 ha, million kcal	Costs energy per 1 ha, million kcal	Energy efficiency ratio, Eer
1. $N_{30}P_{60}K_{60}$ + Inoculation (background) - control.	Without liming	9,67	3,44	2,81
	0.5 norms of lime for g. K.	10,05	3,45	2,91
	1.0 norms of lime for g. K.	10,35	3,46	2,99
2. Background + Wuxal Extra CoMo	Without liming	10,39	3,47	2,99
	0.5 norms of lime for g. K.	10,73	3,51	3,06
	1.0 norms of lime for g. K.	11,07	3,54	3,12
3. Background + Wuxal Extra CoMo + Wuxal Microplant	Without liming	11,24	3,59	3,13
	0.5 norms of lime for g. K.	11,61	3,63	3,20
	1.0 norms of lime for g. K.	11,87	3,66	3,23
4. Background + Wuxal Extra CoMo + Wuxal Microplant + Wuxal Calcium, Boron	Without liming	11,91	3,68	3,24
	0.5 norms of lime for g. K.	12,29	3,71	3,31
	1.0 norms of lime for g. K.	12,55	3,73	3,36

This assessment allows us to clearly determine the levels of resource consumption and propose the most economical measures to reduce the energy intensity of pea grain [9]. The highest energy consumption on the option Background + Wuxal Extra CoMo + Wuxal Microplant + Wuxal Calcium, Boron for maximum soil liming (1.0 lime rates per hectare) – 3.73 million kcal, this is due to the maximum intensification of cultivation vegetable peas in this version of the experiment. However, the high grain yield of vegetable peas, which accumulated the highest energy values – 12.55 and 14.87 million, kcal provided a high coefficient of energy efficiency in our research, which in the variety.

Table 4.

The energy efficiency of growing Somerwood vegetable peas depending on liming and foliar fertilization, average 2017-2019

Foliar feeding factor C	Liming factor B	The energy intensity of the crop from 1 ha, million kcal	Costs energy per 1 ha, million kcal	Energy efficiency ratio, Eer
1. $N_{30}P_{60}K_{60}$ + Inoculation (background) - control.	Without liming	11,99	3,44	3,49
	0.5 norms of lime for g. K.	12,29	3,45	3,56
	1.0 norms of lime for g. K.	12,51	3,46	3,61
2. Background + Wuxal Extra CoMo	Without liming	12,76	3,47	3,67
	0.5 norms of lime for g. K.	12,97	3,51	3,69
	1.0 norms of lime for g. K.	13,22	3,54	3,73
3. Background + Wuxal Extra CoMo + Wuxal Microplant	Without liming	13,35	3,59	3,71
	0.5 norms of lime for g. K.	13,56	3,63	3,74
	1.0 norms of lime for g. K.	13,82	3,66	3,77
4. Background + Wuxal Extra CoMo + Wuxal Microplant + Wuxal Calcium, Boron	Without liming	14,20	3,68	3,86
	0.5 norms of lime for g. K.	14,58	3,71	3,93
	1.0 norms of lime for g. K.	14,87	3,73	3,99

Skinado was 3.36, and Somerwood – 3.99. The lowest was the coefficient of energy efficiency in the control version of the study in the variety Skinado - 2.81 and the variety Somerwood – 3.49. That is, despite the reduction in energy costs of growing vegetable peas and the energy accumulated in the grain harvest provides the lowest energy efficiency in our research.

Conclusions:

Given that the control variant applied mineral fertilizers in the norm $N_{30}P_{60}K_{60}$ and carried out pre-sowing treatment of seeds with an inoculant, the lion's share of costs compared to other alternatives is the background of the control variant, which has been essentially superimposing on additional variants. However, the low profitability of the control option is the cause of high costs for mineral fertilizers, and a small gradual increase in yield due to seed treatment with trace elements, soil liming, foliar fertilization is quite understandable in increasing the profitability of growing peas.

The most important indicator of economic efficiency is profit. The economic efficiency of growing vegetable peas has been characterizing by positive results in all variants of the experiment. This indicator was the lowest in the control (7553-8601 and 11989-12630 UAH / ha), it was higher in the second, as well as the third and fourth versions of the research (8596-9644 and 13020-13673 UAH / ha); 14399 UAH / ha); (10548-11517 and 14814-15862 UAH / ha). That is, with the increase in the level of yield due to the intensification of the technology of growing crops, the profit of the expended products gradually increases. Reaching its maximum in the fourth version of the study, due to the synergistic interaction of nutrients, the return on fertilizers increases.

The high grain yield of vegetable peas, which accumulated the highest energy values – 12.55 and 14.87 million, kcal provided a high coefficient of energy efficiency in our studies, which in the variety Skinado was 3.36, and in the variety Somerwood – 3, 99.

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