

PRODUCTIVE AND ENERGETIC EVALUATION OF GROWING CORN AND SOYA MIXTURE FOR SILAGE

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Abstract

The crop yield of green mass of corn and soya mixtures during the wax ripeness of corn grain of the variety "Dniprovska 310" and the full ripening of soya grain of the variety "Podilska – 1" grown on the agricultural backgrounds without fertilizers and (NPK)₄₅ has been determined during the scientific and research experiment. The seeding rate of corn and soya in the mono specific crops was 25 kg/ha and 80 kg/ha, respectively, but in three mixtures - corn 25 kg/ha, soya 20 kg/ha, 40 kg/ha and 60 kg/ha, that was, respectively, 25 %, 50 % and 75 % of the seeding rate of soya in the mono specific crops. The use of mineral fertilizers provided the increase in the yield of corn and soya mixtures for the above options by 2000 kg/ha, 3700 kg/ha and 3000 kg/ha, respectively. The highest crop yield of green mass – 40400 kg/ha was produced by the option with mineral fertilizers and the seeding rate: corn - 25 kg/ha and 40 kg/ha, it exceeded the mono specific crop of corn by 2200 kg or 5.8%.

At the mixed sowing of corn and soya the content of protein in the dry matter of crop yield of the mixture on the agricultural background without fertilizers increased 1.30 - 1.61 times but on the agricultural background with fertilizers - 1.49 - 1.69 times as compared with the mono specific crop of corn and the content of fat increased 1.17 - 1.67 times and 1.07 - 1.37 times, respectively. The use of corn and soya mixtures had a positive impact on the main energetic performances of their growing as compared with mono specific sowing of corn. The yield from 1 ha of gross and metabolizable energy increase, respectively, by 12.4 - 10.7% and 10.3 - 11.5%, the energy consumption of 100 kilograms of protein decreased nearly twice.

The replacement of corn silage by corn and soya one in the composition of feed mixtures for dairy cows promoted the increase in their daily milk yields by 3.0 kg or 11.3% and fat in milk – by 0.2 % at the absolute favorable performances of energy consumption for milk production.

Key words: corn, soya, mixed crop, energy consumption, milk, milk fat

INTRODUCTION

Formulation of the problem. The scientific literature has repeatedly reported that the vegetative mass of soybeans is of high biological value [1, 3], and silage from a mixture of green mass of corn and soya stimulates the increase in milk yield in cows and their fatty milk production [4].

An analysis of recent studies and publications shows that this is due to the high content of protein in soybeans and its vegetative mass, essential fatty acids and unidentified substances [4], which are formed

during the vegetation of this culture. It was assumed that such substances may be isoflavonoids [3].

Unsolved issues of the past remain issues related to the use of compatible maize and soybean crops on silage, in particular with regard to the technology of compatible maize and soybean crops, the impact of corn-soybean silage on the productivity of ruminant animals, the quality of their products, the reproductive function and economic feasibility of their application.

The purpose of the work was to determine the effectiveness of a number of tools aimed at improving the technology of growing compatible crops and soybeans on silage, the productive and energy evaluation

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of their application, the impact of corn-soybean silage on the milk yield of cows and the quality of their milk.

MATERIAL AND METHOD

Objects and methods of research.

Scientific work was carried out on the experimental field of the Institute of Animal Husbandry of NAAS, and experiments on animals in the DPDG "Kutuzivka" of the Institute of Animal Husbandry of NAAS in 2002-2005.

The seeds of the maize hybrid, Dniprovsk-310 and soybeans of the Podolsk-1 variety were used, with the full norm of seeding, respectively, 25 kg / ha and 80 kg / ha.

Soils of experimental sites are typical, medium-humus, deep-graining, heavy-gravel black earths on the forest.

In the forty centimeter area of these soils contained: humus 4.7-5.6%, potassium - 9.4-13.5 mg per 100 g, nitrogen nitrate - 0.85-1.18, ammonia nitrogen - 0.93- 1.58, light-mobility forms of phosphorus – 6.9-11.0 mg per 100 g.

Area of sites in scientific experiments - total 65 m², credit - 50 m². Area of areas in industrial experiments - 100-120 ha. Repetition in scientific experiments is threefold.

Agrofond feed - control (without fertilizers), N₄₅P₄₅K₄₅.

The sowing was carried out in regular terms (May 1-5) with the use of a NWT-3.6 seeder in a tractor with MTZ-80. Since Ukraine has no seedlings for simultaneous sowing both corn seeds and soya in one row, this operation was carried out in two steps: the first aggregate of machines sowed corn seeds, followed by a second aggregate of machines for sowing in the same row of soybeans.

To control the weeds, the pre-planting of the soil with herbicide Harnes was carried out at a dose of 3 l / ha.

Harvesting was carried out (depending on the tasks in the experiments) in certain phases of development of plants, in particular, the vegetative mass of corn was mowed into the phase of wax graining, in its compatible crops with soy - in the beginning

of the wax and in the waxy curvature of the grain, when the soybean reached full filling of the grain .

The production and energy assessment of the cultivation of single-seed crops of corn and soybeans and their mixtures was carried out in accordance with existing standard methods and technological crop cultivation of forage crops and the standard method of energy assessment of technologies in fodder production [2, 5].

RESULTS AND DISCUSSIONS

Main results of the study. Mixed corn and soybean crops for the norm of seeding corn seeds 25 kg / ha and soybeans 20 kg / ha, as well as the same amount of corn grain, and soybeans - 40 kg / ha or 60 kg / ha per yield of green mass prevailing single-line corn sowing, and even more soy soybeans as if using mineral fertilizers, and without them (Table 1). The need to use Agrofond without fertilizers can be explained by the fact that in the conditions of the economic crisis that existed in Ukraine at that time, many farms, especially small farmers, worked in the conditions of limited logistical support, therefore an agrofond was used. In addition, it was necessary to find out how the compatible crops of corn and soybeans that were used to react to the use of mineral fertilizers.

In the agroforest without fertilizers, all three compatible crops of corn and soybeans, irrespective of the amount of used soybean seeds, had practically the same yield of green mass (within 367-371 c / ha). Under the conditions of application of mineral fertilizers - (NPK) 45 the maximum yield of green mass - 404 centners per hectare was achieved on the variant of experiment 4, when half (40 kg / ha) of seed soybean seed was used in addition to maize. According to this experiment, the yield of the green mass of the combined sowing of maize and soybeans was dominated by single-line corn sown at 22, or 5.8%.

The use of more soybean seeds (60 kg / ha or 75% of the norm) was not accompanied by a significant increase in the green mass crop or other indicators characterizing the

feasibility of such a crop, compared with the use of the use of sowing seeds to corn 40 kg / ha (50% from the norm in single species her crops). Thus, in variant 5, in comparison with option 4, although the agroforest with no fertilizers increased the yield of green mass by 4, or 1.1%, however, on the agroforest (NPK) 45, on the contrary, the yield of the

mixture of green mass decreased by 3 q or 0.7%. And on other indicators, in particular, on the way out of a unit of land area of dry matter, feed units, digestible protein, feed-protein units, exchange energy on agrofond with mineral fertilizers, the variant of sowing had an advantage over 5 variants of experiment (Table 1).

Table 1 Gravity of green mass and nutrient collection in compatible crops of corn and soybeans (average over 3 years, c / ha)

Variant crops	Agrofon	Green mass	Including z / m soya		Dry wines	Corresponding to one	Per-germic protein	Feed proteins are new units	OE, GJ / ha
			ts / ha	% of the total mass					
Corn (norm) single-seeded sowing	Without fertilizers	353	-	-	89.0	84.7	2.83	56.5	100.6
	(NPK) ₄₅	382	-	-	107.1	91.7	3.86	65.1	115.1
Soya (norm) single-seeded sowing	Without fertilizers	194	194	100	53.2	44.2	6.69	55.5	40.9
	(NPK) ₄₅	211	211	100	58.8	51.3	7.65	63.8	48.8
Corn (norm) + soybeans (25% of the sowing rate)	Without fertilizers	370	51.3	12.8	97.2	86.9	4.81	67.8	106.9
	(NPK) ₄₅	390	54.5	12.9	105.5	94.6	6.28	77.2	116.0
Corn (norm) + soybean (50% of the sowing rate)	Without fertilizers	367	65.8	16.6	102.5	91.7	4.23	67.0	113.8
	(NPK) ₄₅	404	67.5	15.6	108.0	100.2	7.18	86.0	120.8
Corn (norm) + soybeans (75% of the sowing rate)	Without fertilizers	371	73.6	19.7	104.0	93.1	6.14	77.2	114.5
	(NPK) ₄₅	401	75.6	18.0	105.0	99.8	7.08	85.3	118.6

Explain the obtained results of researches as the fact that excessive thickening of plants was reached on the crops of variant 5, and the fact that the not perfectly perfect method of sowing of soybean seeds was used because of the lack of a seeder for simultaneous separation of seed of corn and soya. In the real languages of the experiment, soybean seeds could fall into one socket with corn grain or be taken into a zone between the rows, where its ascents popped out during inter-row cultivation of the soil.

The study of the chemical composition of green maize and the combined corn and soybean crops showed that due to soy, the yield of protein and fat increased both on the control agrofond and in the application of

mineral fertilizers (Table 2). Thus, in the green mass obtained on the variants of studies 3, 4 and 5 on the agroforest without fertilizers, the protein content, in comparison with option 1, increased by 1.43; 1.30 and 1.61 times, respectively, and on agrofond with mineral fertilizers - 1.49; 1.66 and 1.69 times. Under these conditions, the amount of fat in the green mass of compatible crops of corn and soybeans increased to 1.17; 1.44; 1.67 times and 1.28; 1.07 and 1.37 times (Table 2).

Due to the increase in the amount of protein and fat, the green mass of compatible corn and soybean crops contained less BER for practically the same amount of fiber, compared with the control variant - single-seeded corn.

Table 2 The chemical composition of the green mass of corn and the combined crops of corn and soybeans on silage (average over 3 years),% on absolutely dry matter

Variants of crops	Agrofony	Ashes	Fat	Protein	Cellulite	BER
Corn (the beginning of wax ripeness)	Without fertilizers	4.68	2.30	5.48	23.77	63.04
	(NPK) ₄₅	4.30	2.90	6.22	22.67	63.13
Soya (full grain filling)	Without fertilizers	7.22	5.62	16.81	27.06	41.26
	(NPK) ₄₅	6.96	6.12	17.46	27.15	40.29
Corn + soybeans (25% of the seed rate)	Without fertilizers	5.50	2.69	7.83	23.18	59.84
	(NPK) ₄₅	4.68	3.70	9.28	22.14	59.19
Corn + soybean (50% of seed rate)	Without fertilizers	4.63	3.31	7.11	23.31	60.75
	(NPK) ₄₅	4.49	3.09	10.33	23.37	57.65
Corn + soybean (75% of the seed rate)	Without fertilizers	4.69	3.85	8.83	23.71	50.75
	(NPK) ₄₅	5.22	3.98	10.54	24.66	54.54

According to the results of a special scientific experiment, which determined the energy assessment of the cultivation of cereals, legumes, grain legumes and their mixtures, it was established (Table 3) that corn-soya mixtures, in comparison with single-grain maize, ensured the growth of gross energy per unit of land on 14.61 and

18.9 GJ / ha or by 8.3% and 10.7%, and the exchange energy - by 8.8 and 9.8 GJ / ha or by 10.3% and 11.5%. At the same time, the energy factor and the coefficient of energy efficiency were not significantly but increased, and the increase of gross energy from 1 hectare of such crops increased by 9.3% and 11.9% (Table 3).

Table 3 Energy assessment of the cultivation of corn-soya mixtures for silage

Options	Costs of total energy, GJ / ha	Exits from 1 hectare, GJ		Energy intensity 1t, GJ			Energy coefficient	Energy efficiency factor	Growth of gross energy, GJ
		gross energy	exchange energy	exchange energy	feed units	digestible protein			
Corn (single-seeded crop)	24.6	176.19	85.24	0.25	0.29	6.7	7.16	3.46	151.55
Corn + soybean (25% of the sowing rate)	25.1	190.80	94.05	0.24	0.27	4.0	7.60	3.74	165.70
Corn + soybean (50% of seed rate)	25.5	195.10	95.04	0.24	0.25	3.5	7.68	3.72	169.60

In a scientific and economic experiment conducted in DPDG "Kutuzovka" in 2005, for complete replacement of corn silage corn cow corn-soya, their average daily milk yield

increased from 21.39 ± 0.56 kg to 24.35 ± 0.61 kg or 11.3%, and the fat content of milk increased from 3.61% to 3.81% or 0.2% of absolute (Table 4).

Table 4 Productivity of cows (on average, 1 cow per day)

Roups of cows	At the beginning of the experiment		At the end of the experiment		On average, for experiments		
	hopes, kg	% fat	hopes, kg	hopes, kg	hopes, kg	hopes, kg	milk with fat content 3.4%, kg
Control (Basic Rice + Corn Silage)	20.6±0.75	3.61±0.26	21.35±0.79	3.54±0.31	21.39±0.56	3.61±0.28	22.71
Experimental (Basic Rice + Corn Soybean Silage)	21.4±0.57	3.67±0.11	24.35±0.70	3.85±0.11	24.15±0.61	3.81±0.11	27.06

Attention is drawn to the significant increase in the fat content of milk of cows fed with corn-soybean silage. This is explained by the increased content of digestible protein and fat in the combined silage, and the presence in a soybean of a certain group of biologically active substances, in particular phenolic nature, such as flavones, isoflavonoids (isoflavones), oxycumarins, and others. Probably, in the first place, with isoflavonoids the increase of fatty milk production of cows is identified.

CONCLUSIONS

1. Co-crops of corn and soybeans on green fodder and silage in a scientifically based selection of maize hybrids and soybean varieties on terms of vegetation and vegetation yields provide on agrofond (NPK) 45, in comparison with single-grain corn crops, increase in the yield of green mass of compatible crops in wax corn grain rutting and full soybean filling of 22 centners per hectare or 5.8%

2. The appropriate norm for sowing seeds in corn-soya beans: corn 25 kg / ha and soybeans 40 kg / ha in one row with corn.

3. With the use of compatible crops of corn and soybeans on silage, an increase in protein content in vegetative mass is increased by 1.7 times, and fat - in 1.3 times, compared to single-seeded corn, and the output of energy from 1 hectare of sowing increases by 11.5% for the receptive parameters of the energy factor and the coefficient of energy efficiency.

4. For complete replacement of corn silage on corn-soya in the composition of

feed mixtures daily milk yield of cows increased by 11.3%, and fat content of milk - by 0.2% absolute.

5. Further development of scientific research in this aspect should be directed at the development and introduction into production of a seeder for simultaneously normalized sowing separately seeds of corn and soybeans in one line, the selection of high-yield hybrids of corn and soybeans with optimum their rigidity at the moment of mowing the mixture of these crops on silage and the identification of effective herbicides that are not harmful to both of these crops.

REFERENCES

- [1]. Babich A.O. Vegetable protein and soybean belt of Ukraine / Babich AO, Petrichenko V.F. // Bulletin of Agrarian Science, 1992. - No. 7. - P. 1-5.
- [2]. Babich A.O. Method of conducting experiments on fodder production / A.O. Babych. - Vinnytsya: Institute of feed of UAAS, 1994. - 96 p.
- [3]. Gnoyevy IV System of stable production and efficient use of feed for year-round feeding of the same type of highly productive cows: [methodical and practical manual] / I.V. Gnoyevy, O.K. Trishin. - Kh.: Magda Ltd., 2007. - 95 p.
- [4]. Kulik MF Biologically active soy substances - stimulators of milk lipids synthesis in the body of cows / Kulik MF, Zhmud O.V., Obertyukh Yu.V. // The Bulletin of Agrarian Science. - 1999. - October. - P. 37-38.
- [5]. Typical technique of integrated energy evaluation of feed production technologies. - Doslidnitskoe, 1985.- 35 p.