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PRODUCTIVITY OF MIXED CROPS OF CORN WITH LEGUMINOUS CROPS ON SILAGE IN THE CONDITIONS OF VINNYTSIA REGION

ПРОДУКТИВНІСТЬ ЗМІШАНИХ ПОСІВІВ КУКУРУДЗИ З БОБОВИМИ КУЛЬТУРАМИ НА СИЛОС В УМОВАХ ВІННИЦЬКОЇ ОБЛАСТІ

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Abstract. *The results of research on the influence of elements of technology of growing mixed crops of maize with soya and beans on silage on the formation of their feed productivity are presented. It was found that the maximum yield of green mass at the level of 51,6-55,7 t/ha was formed by mixed corn crops with soya or beans feed on condition of their drying in one row and introduction* $N_{120}P_{60}K_{90}$*. The corn-soya mixture is more productive.*

Key words: *Corn, soybeans, fodder, mixed crops, yield, vegetative mass.*

Introduction.

Providing the population with high-quality food in full is the most important task of the agro-industrial complex. The solution of this problem depends to a large extent on the development of the livestock industry, the efficiency of which is conditioned by the availability of sufficient quantity of full-fledged fodder, which in the structure of expenses for production of animal products occupy 50-60 %, and therefore their cost of production significantly influences the profitability of animal production. That is why the organization of forage production at the modern technological level of growing of forage crops and cash balanced by the most important elements of feed is an important economic task, the solution of which will contribute, in general, to increase the profitability of agricultural production [2, 4, 5, 8].

One of the main types of canned food is silage. The main silage culture in Ukraine is corn, whose feed characteristics are well known. However, the green mass of its single crop is poorly balanced by the content of nutrients, first of all, by the crossing protein, whose deficit in the ready feed is 30-40 g/k od. This problem can be solved by growing maize in mixed crops with high-protein crops, such as soybeans and beans. This will increase the productivity of the feeding area and get well-balanced by the content of the cross-equal protein and other nutrients raw material for silage filling [1, 3, 10].

Materials and methods of research. Field investigations were carried out during 2020-2021 on the fields of "Zoloti Luki" LLC, which is located in the Illynets district of Vinnytsia region in the right-bank part of Ukraine on the gray forest soil.

The following scheme was used: Factor A – method of sowing (1. Maize (control), 2. Soja, 3. Bobe fodder, 4. Maize + soya (in 1 rows), 5. Corn (1 rows) + soya (1 rows), 6. Corn (2 rows) + soya (1 rows), 7. Corn (2 rows) + soya (2 rows), 8. Corn + feed beans (1 rows), 9. Corn (1 rows) + feed beans (1 rows), 10. Corn (2 rows) + feed beans (1 rows), 11. Corn (2 rows) + feed beans (2 rows); factor B – norms of mineral fertilizers, kg/ha in. p.: 1. Without fertilizers (control), 2. $N_{90}P_{60}K_{90}$. 3. $N_{120}P_{60}K_{90}$.

The precursor is winter wheat. The norm of corn production is 80 thousand pieces/ha; soybeans and beans of feed on 220 thousand pieces / per ha; in single-legumes and soybeans of 600 thousand/ha. During the investigation, the average orange hybrid of maize Codival (FAO 290), soybean type Bohemians and fodder bean variety Bilun were used filling [3, 6, 9].

Results of research and their discussion.

Studies of many scientists have found that due to legumes crops the yield of silage mass in mixed crops increases by almost 34%, compared to single-crop crops of maize [1, 7, 8]. However, in areas with insufficient moisture, the yield of mixed crops can be at the same level as the same crop of corn.

As a result of our research, it has been established that at the growing of the maize hybrid Codival (FAO 290) on the non-fertilized background of the highest yield had the same crop of corn (table 1). The yield of green mass from the crops of mixtures on unfertilized areas due to the suppression of legumes of corn plants significantly decreased.

The introduction of mineral fertilizers in the norm $N_{90}P_{60}K_{90}$ on the variant where the compatible crops of the soya type Bohemians were grown according to the method of sowing, which provided for planting in one row, did not significantly increase the yield of the green mass, and in the condition of 2021, in general, the yield level (58,5 t/ha) was at the level of control – 58,2 t/ha. Corn and bean mixtures of Bilun, hanging in the same row, somewhat inferior to corn and soya, but not much. In other variants, where the methods of sowing on the area of the grain and bean component were studied, both in the mixture of corn and soya, and in the mixture of corn and beans of feed yield of green mass of these mixtures were inferior to the same seeds of corn.

Increase of nitrogen fertilizer dose up to 120 kg/ha in. In the background of the same standard of phosphorus-potassium fertilizers ($P_{60}K_{90}$), the yield of green mass increased significantly in both two years of research in mixed crops of corn and soybeans in one row, where the yield of green mass exceeded control and amounted to in 2020 and 2021, respectively, 31,5 and 62,3 tons/ha, against control 34,3 and 68,8 tons/ha.

Thus, the yield of mixed crops of maize hybrid Codival with high-protein components on silage depended on the norms of mineral fertilizers, method of sowing and debition of bean component . The highest yield was formed mixed corn crops with Bogemians soybean in one row, when mineral fertilizers were applied, both in

norm $N_{90}P_{60}K_{90}$ and norm $N_{120}P_{60}K_{90}$. Growth by other means of placing maize and bean components on the area caused the formation of a smaller yield of green mass. For all variations of fertilizer, single-crop soybeans and fodder beans formed the lowest yield of the green mass.

1. The yield of vegetative mass of single and mixed crops of corn, soya and feed beans depends on technological measures of cultivation, t/ha

Variant	Fertilizer		
	no fertilizers	$N_{90}P_{60}K_{90}$	$N_{120}P_{60}K_{90}$
Maize (control)	39,4	46,0	51,6
Soya	14,3	16,2	18,4
Bean	11,6	13,2	14,8
Maize + Soya (1)	37,0	47,1	55,7
Maize (1) + Soya (1)	30,8	40,5	46,9
Maize (2) + Soya (1)	33,7	45,0	50,9
Maize (2) + Soya (2)	30,9	40,9	46,4
Maize + Beans(1)	33,8	44,7	51,6
Maize (1) + Beans (1)	28,9	39,0	44,0
Maize (2) + Beans (1)	32,0	42,8	48,4
Maize (2) + Beans (2)	27,9	38,0	42,8
HIP_{05}	2,02		

The greatest value of mixed corn crops with leguminous crops is that relatively single corn crops provide higher yield of over-flowing protein, thus balancing feed according to this indicator and preventing its overconsumption. According to a number of researchers, due to the use of mixed crops, the output of the protein crossing increases by 25%, relatively pure corn crops [2, 3].

It has been found that on the variant without mineral fertilizers the greatest content of the protein crossing was observed in the green mass obtained from the compatible crops of maize and bean components (tab. 2) and became, depending on the method of sowing, in mixtures of corn with a soya 0,51-0,62 t/ha, in mixtures of corn with legumes of feed – 0,45-0,54 t/ha. The lowest output of the protein is marked in the single-leguminous crops of feed and corn – 0,40 and 0,44 tons/ha respectively.

With the introduction of mineral fertilizers in the norm $N_{90}P_{60}K_{90}$ increased the output from the unit of the area of crossing protein on all variants of the field investigation. However, the greatest increase in the yield from one hectare of overflowing protein was noted under the conditions of double dose of nitrogen fertilizers on the background of $P_{60}K_{90}$.

The most significant growth of the protein-to-protein ratio was obtained with the introduction of $N_{120}P_{60}K_{90}$ on the variants where corn with soya in one row, and corn with beans in one row – the obtained values exceeded the control, respectively, by 0,32 and 0,18 tons/ha. There were no significantly less variations in this indicator, where the same mineral background, corn and legumes were planted in the ratio of 2 rows of cereals and one – bean component. According to this method of sowing, the output of the crossing protein was 0,68-0,72 t/ha, depending on the type of high-protein culture. A significant reduction in the collection of protein-like protein was in

variants with the simultaneous sowing of fodder beans.

2. The output of a protein-to-protein from single and mixed corn crops with leguminous crops in silos, depending on technological measures of cultivation, t/ha, average for 2020-2021

Variant	Fertilizer		
	no fertilizers	$N_{90}P_{60}K_{90}$	$N_{120}P_{60}K_{90}$
Maize (control)	0,44	0,54	0,64
Soya	0,46	0,53	0,55
Bean	0,40	0,44	0,46
Maize + Soya (1)	0,61	0,76	0,96
Maize (1) + Soya (1)	0,51	0,64	0,65
Maize (2) + Soya (1)	0,55	0,71	0,72
Maize (2) + Soya (2)	0,62	0,64	0,66
Maize + Beans (1)	0,54	0,71	0,82
Maize (1) + Beans (1)	0,47	0,60	0,61
Maize (2) + Beans (1)	0,50	0,64	0,68
Maize (2) + Beans (2)	0,45	0,59	0,62
HIP_{05}	0,05	0,05	0,06

Thus, at the output of the crossing protein variant with mixed seeds of corn with leguminous crops prevailed the single crop of corn, both in the absence of mineral fertilizer and at its introduction. The highest value of the cross-protein output is marked on areas with mixed corn crops with soya in one row for the use of mineral fertilizers in norm $N_{120}P_{60}K_{90}$.

Conclusions.

When growing mixed crops of corn with beans in silage, it is expedient to use soya and beans. In order to obtain 51,6-55,7 tons/ha of quality raw material for silage filling of components of the mixture should be carried out in one line and mineral fertilizers should be introduced in norm $N_{120}P_{60}K_{90}$. The corn-soya mixture is more productive.

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Анотація. *Викладені результати досліджень щодо вивчення впливу елементів технології вирощування змішаних посівів кукурудзи з соєю та бобами кормовими на силос на формування їх кормової продуктивності. Встановлено, що максимальна урожайність зеленої маси на рівні 51,6-55,7 т/га була сформована змішаними посівами кукурудзи з соєю або бобами кормовими за умови їх висівання в один рядок та внесення $N_{120}P_{60}K_{90}$. Більш продуктивною є суміш кукурудзи з соєю.*

Ключові слова: *кукурудза, соя, боби кормові, змішані посіви, урожайність, вегетативна маса.*

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