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THE EVALUATING METHOD OF THE BIOLOGICAL ACTIVITY AND RELATIVE PRODUCTIVITY FOR MIXED AND COMBINED THREE-COMPONENT CROPS

Vladimir OVTOV[1], Oksana OVTOVA[2]

[1]Penza State Agrarian University, 30 Botanicheskaya Street, 440014, Penza, Russia
[2]State Center of Agrochemical Servises "Penzenskiy", 150 Kalinina Street, 440034, Penza, Russia

Corresponding author email: Ovtovvlad@mail.ru

Abstract

The production of cheap energy-rich and high-protein feed is possible due to the introduction of new types of feed crops. The use of new perennial low-growing crops based on the agrocenoses will make it possible to obtain cheap energy-saturated and high-protein feeds. In addition to the selection and introduction of new species of forage grasses, it is also necessary to evaluate their biological effectiveness in joint and mixed crops. A technique is proposed for assessing the biological activity and relative productivity of mixed and combined three-component crops. Formulas for calculating the land equivalents ratio (LER) and competitiveness coefficients (CR) in three-component mixtures are given. The proposed methodology is based on methods for assessing two-component mixed crops. According to the proposed method, the calculations of LER and CR of three-component joint and mixed crops of legumes, cereals and cruciferous herbs were carried out.

***Key words**: three-component crops, high-protein feed, mixed agrocenoses, perennial herbs.*

INTRODUCTION

Currently, a very limited number of plant species are used in the feed production system. Expanding the assortment of feed crops through the introduction of new species may become a source of increasing production of cheap energy-rich and high-protein feeds. In this regard, the organization of adaptive fodder production based on the mixed agrocenoses through the selection of crops and the introduction of new species of forage grasses is of great importance (Ovtova et al., 2005).

One of the important aims in the fodder production is to find out, on the basis of resource-saving technologies, economically viable long-term agrocenoses with using new and perennial rare crops in order to obtain various types of feed.

The feasibility of widespread use of mixed crops was pointed out by K.A. Timiryazev, who noted that a plot of land sown with several varieties of grass gives a greater yield of hay than an area of equal size sown with the same species of grass.

The relationship of plants in mixed crops depends on the biological nature of different plant species and on environmental conditions. Given these parameters, it is possible to identify and select crops and varieties that most fully use the areas of cohabitation and vegetation time (Timoshkin et al., 2011).

Until recently, it was believed that high-quality herbage is produced only from a grass mixture consisting of 5-6 or more types of herbs with different biology (loose bush, rhizome) and a different formation of the shoot and of the foliage (top, half-top and bottom). However, under conditions of intensification and agricultural specialization, with a significant amount of work on the radical improvement of meadows, an increase in crop rotation area under grasses, it is difficult to seed so many herbs.

The purpose of the current article is to describe the new method for assessing the biological activity and relative productivity of mixed and combined three-component crops.

MATERIALS AND METHODS

Multivariate field experiments were carried out. In the first experiment, the comparative productivity of perennial herbs was studied. These perennial herbs were not mixed and we examined the productivity of every mentioned below herbs separately.

1. *Bunias orientalis* L.
2. *Galega orientalis* L.

3. *Medicago sativa* L.
4. *Trifolium pratense* L.
5. *Bromopsis inermis* Holub
6. *Dactylis glomerata* L.

In the second experiment, we examined *Bunias orientalis* L. in mixed crops. The second experiment was also bifactorial: Factor A (grass mixture) and Factor B (sowing method).

Factor A (grass mixture)

Bunias orientalis L. + *Galega orientalis* L.
Bunias orientalis L. + *Medicago sativa* L.
Bunias orientalis L. + *Trifolium pratense* L.
Bunias orientalis L. + *Dactylis glomerata* L.
Bunias orientalis L. + *Bromopsis inermis* Holub
Bunias orientalis L. + *Galega orientalis* L. + *Bromopsis inermis* Holub
Bunias orientalis L. + *Galega orientalis* L. + *Dactylis glomerata* L.
Bunias orientalis L. + *Medicago sativa* L. + *Bromopsis inermis* Holub
Bunias orientalis L. + *Medicago sativa* L. + *Dactylis glomerata* L.
Bunias orientalis L. + *Trifolium pratense* L. + *Bromopsis inermis* Holub
Bunias orientalis L. + *Trifolium pratense* L. + *Dactylis glomerata* L.

Factor B (sowing method)

1. Even spacing between individual seeds in the row.
2. Cross-sowing.

Pure crop seeding rates: *Bunias orientalis* L. - 40 kg/ha, *Galega orientalis* L. - 20 kg/ha, *Medicago sativa* L. - 12 kg/ha, *Trifolium pratense* L. - 10 kg/ha, *Bromopsis inermis* Holub - 20 kg/ha, *Dactylis glomerata* L. - 18 kg/ha. In grass mixtures, the sowing rate of legumes and *Bunias orientalis* L. was reduced by 20%, bluegrass - 2 times. One of the most common criteria for assessing the biological activity of mixed crops is the land equivalents ratio (LER) (Willey et al., 1980). In this case we used a well-known method for assessing biological activity for two-component mixtures, where LER is calculated by the formula given below:

$$LER = \frac{Y_{AB}}{Y_{AA}} + \frac{Y_{BA}}{Y_{BB}} = \frac{Y_{AB} \cdot Y_{BB} + Y_{BA} \cdot Y_{AA}}{Y_{AA} \cdot Y_{BB}},$$

where:

Y_{AA} - crop yield (component A) in clean sowing, t/ha;

Y_{BB} - crop yield (component B) in clean sowing, kg/ha;

Y_{AB} - crop yield (component A) in mixed sowing, t/ha;

Y_{BA} - crop yield (component B) in mixed, kg/ha.

To evaluate the relative productivity of crops in mixed crops, a competitive coefficient (CR) is used.

According to a known method for two-component mixtures, CR is calculated by the formula:

$$CR_{AB} = \frac{Y_{AB}}{Y_{AA}} : \frac{Y_{BA}}{Y_{BB}} \cdot \frac{z_{BA}}{z_{AB}} = \frac{LER_A \cdot z_{BA}}{LER_B \cdot z_{AB}},$$

where:

LER_A - the ratio of the land equivalent of the crop (component A) in clean sowing;

LER_B - ratio of land equivalent of crop (component B) in clean sowing;

z_{AB} - proportion of culture (component A) in the mixed crop;

z_{BA} - proportion of culture (component B) in the mixed crop.

Based on the evaluation methodology for LER of two-component mixtures, a methodology is proposed for assessing the Land Equivalents ratio (LER) in three-component mixtures.

The land equivalents ratio (LER) is determined by the formula:

$$LER = \frac{Y_{ABC}}{Y_{AA}} + \frac{Y_{BAC}}{Y_{BB}} + \frac{Y_{CAB}}{Y_{CC}} = \frac{Y_{ABC}Y_{BB}Y_{CC} + Y_{BAC}Y_{AA}Y_{CC} + Y_{CAB}Y_{AA}Y_{BB}}{Y_{AA} \cdot Y_{BB} \cdot Y_{CC}},$$

where:

Y_{AA} - crop yield (component A) in clean sowing, t/ha;

Y_{BB} - crop yield (component B) in clean sowing, kg/ha;

Y_{CC} - crop yield (component C) in clean sowing, t/ha;

Y_{ABC} - crop yield (component A) in mixed sowing, t/ha;

Y_{BAC} - crop yield (component B) in mixed sowing, t/ha;

Y_{CAB} - crop yield (component C) in mixed sowing, t/ha.

Then the land equivalents ratio (LER) of the components of the mixture is determined as follows:

$$LER_A = \frac{Y_{ABC}}{Y_{AA}};\; LER_B = \frac{Y_{BAC}}{Y_{BB}};\; LER_C = \frac{Y_{CAB}}{Y_{CC}},$$

$$LER_{AB} = \frac{Y_{BAC}}{Y_{BB}} + \frac{Y_{ABC}}{Y_{AA}} = \frac{Y_{BAC} \cdot Y_{AA} + Y_{ABC} \cdot Y_{BB}}{Y_{BB} \cdot Y_{AA}};$$

$$LER_{AC} = \frac{Y_{CAB}}{Y_{CC}} + \frac{Y_{ABC}}{Y_{AA}} = \frac{Y_{CAB} \cdot Y_{AA} + Y_{ABC} \cdot Y_{CC}}{Y_{CC} \cdot Y_{AA}};$$

$$LER_{BC} = \frac{Y_{BAC}}{Y_{BB}} + \frac{Y_{CAB}}{Y_{CC}} = \frac{Y_{BAC} \cdot Y_{CC} + Y_{CAB} \cdot Y_{BB}}{Y_{BB} \cdot Y_{CC}}.$$

Using the above method for determining the competitiveness coefficient in two-component mixtures, we propose a method for determining (CR) in three-component mixtures. Thus, the competitiveness coefficient in ternary mixtures is determined by the formulas:

$$CR_A = \frac{LER_A \cdot z_{BC}}{LER_{BC} \cdot z_A};\quad CR_B = \frac{LER_B \cdot z_{AC}}{LER_{AC} \cdot z_B};$$

$$CR_C = \frac{LER_C \cdot z_{AB}}{LER_{AB} \cdot z_C},$$

where:

LER_A - ratio of the land equivalent of the crop (component A) in clean sowing;

LER_B - ratio of land equivalent of crop (component B) in clean sowing;

LER_C - ratio of land equivalent of crop (component C) in clean sowing;

LER_{BC} - the ratio of the land equivalent of crops (component B and C) in a mixed three-component sowing;

LER_{AC} - ratio of the land equivalent of crops (component A and C) in a mixed three-component crop;

LER_{AB} - ratio of the land equivalent of crops (component A and B) in a mixed three-component crop;

z_{BC} - the proportion of crops (components B and C) in mixed sowing;

z_{AC} - the proportion of crops (components A and C) in mixed sowing;

z_{AB} - the proportion of crops (components A and B) in mixed sowing;

z_A - the proportion of culture (components A) in the mixed crop;

z_B - the proportion of culture (components B) in the mixed crop;

z_C - the proportion of culture (components C) in mixed sowing.

Statistical evaluation for the calculated results influence of the components in the current research and the new sowing method on the green mass yield in perennial grass mixtures (t/ha) was carried out using analysis of variance (ANOVA). The assessment was carried out by comparing the variances of the variants with the variance of the error according to the Fisher test *F* with a 95% probability. Thus, the average square of the random variance, which determines the random error of the experiment, was taken as the base - unit of comparison. In this case, the null hypothesis being tested was the assumption that all sample averages are estimates of the same general average, and, therefore, the differences between them are insignificant. In addition, the significance of particular differences in terms of the smallest significant difference (NDS) was additionally assessed and between what averages there were significant differences. When processing data from multivariate experience, analysis of variance allowed us to identify not only the main effects, but also to assess the significance of their interaction.

RESULTS AND DISCUSSIONS

The assessment showed that the greatest coefficient of biological efficiency is observed with the ordinary method of sowing, various variants of three-component agrocenoses. At the same time, on average for 1 year of vegetation of herbs, this indicator was higher for ordinary than for cross-sowing by 17.8%. In two-component crops, the LER value was less than unity - with ordinary sowing 0.28-0.92 and 0.18-0.90 with cross-sowing (Ovtova et al., 2005). It should also be noted that in double mixtures the highest LER value was observed in mixtures with cereals, regardless of the method of sowing.

In the three-component mixtures of the considered variants, the highest biological efficiency coefficient was found in the agrocenoses of *Bunias orientalis* L. + *Galega orientalis* L. + *Bromopsis inermis* Holub, 1.22-1.34, and *Bunias orientalis* L. + *Galega orientalis* L. + *Dactylis glomerata* L., 1.09-1.25.

So, in the 2nd year of vegetation, the LER value of ternary mixtures was 49.7% higher in row crops and 27.5% in cross crops than in binary crops. In ternary mixtures, the highest biological efficiency coefficient was observed in the agrocenoses of *Bunias orientalis* L. + *Galega orientalis* L. + *Bromopsis inermis* Holub and *Bunias orientalis* L. + *Galega orientalis* L. + *Dactylis glomerata* L. - 1.97 and 1.89. Analysis of the LER of binary mixtures showed that the highest LER was obtained in the agrocenosis of *Bunias orientalis* L. + *Bromopsis inermis* Holub, 1.15, and *Bunias orientalis* L. + *Bromopsis inermis* Holub, 1.06, the remaining mixtures were biologically less effective (Ovtova et al., 2005).

The competitiveness factor of the *Bunias orientalis* L. is mainly determined by the number of components in the agrocenosis and the method of sowing. The number of components in the mixture and the method of sowing had a significant impact on the competitiveness factor of *the Bunias orientalis* L. An increase in the components from two to three contributed to a decrease in the CR value of the *Bunias orientalis* L. by an average of 1.7 times, and the ordinary method of sowing increased the competitiveness of the *Bunias orientalis* L. by an average of 40.4%.

In the first year of vegetation, the highest CR (0.73) of *Bunias orientalis* L. was observed in the binary mixture of *Bunias orientalis* L. + *Galega orientalis* L. broom during row crops, and the highest coefficient of competitiveness was obtained from the *Dactylis glomerata* L. of the national team during cross-sowing (5.00) in the binary mixture with *Bunias orientalis* L.

In the second year of vegetation, the *Galega orientalis* L. is the most optimal component for *Bunias orientalis* L., so in a grass mixture with its participation, the *Bunias orientalis* L. CR is 0.99 for ordinary sowing. Among ternary mixtures, the highest *Bunias orientalis* L. CR was noted in the agrocenosis of *Bunias orientalis* L. + *Galega orientalis* L. + *Bromopsis inermis* Holub, while it can be noted that the coefficient of competitiveness of the bean component of the mixture during cross-sowing increases by 28.3%.

By the third year of vegetation, in two-component and three-component mixtures, an increase in CR of *Bunias orientalis* L. is noted. In the double agrocenoses of the *Bunias orientalis* L. and the *Bromopsis inermis* Holub, the competitiveness coefficient increases to 1.19, and the *Bunias orientalis* L. and the *Galega orientalis* L. grow to 1.02, more than in the second year of vegetation. At the same time, cereal grasses reduce the coefficient of competitiveness of *Bunias orientalis* L., so rump - by 1.7 times, and hedgehog - by 23.6%. An analysis of three-component mixtures of *Bunias orientalis* L. showed that its competitiveness coefficient is lower than in binary mixtures by an average of 2.2 times.

On average, in the first year (Table 1), significant differences were obtained for factor A (set of components); for factor B (sowing method), the same yield (5.4 t/ha) was obtained in the *Bunias orientalis* L. + clover + *Bromopsis inermis* Holub mix. The maximum yield was obtained in the mixture of *Bunias orientalis* L. + clover + *Dactylis glomerata* L. (6.4 t/ha) for row crops, and the minimum (2.2 t/ha) in the variant *Bunias orientalis* L. + *Dactylis glomerata* L. for cross-sowing. On average, the yield of ordinary crops in the first year of vegetation was higher by 17.1%. At the same time, ordinary three-component crops (5.2 t/ha) were the most productive, with cross-sowing, these mixtures yielded 15.6% less green mass. Two-component row crops yielded 23.8% less than the three-component row crops, and with cross-sowing, the difference was 25% compared to the cross three-component crops and 44.4% in comparison with the three-component row crops. In the second and third years of vegetation, a significant influence on factor A was found, with the exception of mixtures of *Bunias orientalis* L. + *Medicago sativa* L. + *Dactylis glomerata* L. and *Bunias orientalis* L. + clover + *Bromopsis inermis* Holub in the third year of vegetation in ordinary crops of the main mowing (Table 1). According to factor B, the yield increase was also seen in the main mowing in all cases except:

Bunias orientalis L. + *Bromopsis inermis* Holub, *Bunias orientalis* L. + *Dactylis* *glomerata* L., *Bunias orientalis* L. + *Medicago sativa* L. + *Bromopsis inermis* Holub in the second year of vegetation in the main mowing and *Bunias orientalis* L. + clover + *Dactylis glomerata* L. - in the third year of the main mowing.

Table 1. Effect of a set of components and the sowing method on the crop of green mass of perennial grass mixtures, t/ha

Variety	Years of vegetation				
	1st	2nd		3rd	
		Main mowing	Aftergrass	Main mowing	Aftergrass
Ordinary crops					
Bunias orientalis L. + *Galega orientalis* L.	4.2	32.5	6.6	35.8	15.8
Bunias orientalis L. + *Medicago sativa* L.	5.3	27.6	4.6	35.6	12.8
Bunias orientalis L. + *Trifolium pratense* L.	5.9	26.8	2.7	35.0	13.2
Bunias orientalis L. + *Dactylis glomerata* L.	3.3	20.3	4.3	24.0	12.0
Bunias orientalis L. + *Bromopsis inermis* Holub	2.3	19.1	3.6	20.4	12.8
Bunias orientalis L. + *Galega orientalis* L. + *Bromopsis inermis* Holub	4.6	36.0	5.7	43.0	19.2
Bunias orientalis L. + *Galega orientalis* L. + *Dactylis glomerata* L.	3.6	34.7	5.9	41.2	20.6
Bunias orientalis L. + *Medicago sativa* L. + *Bromopsis inermis* Holub	5.2	26.0	5.3	32.8	20.2
Bunias orientalis L. + *Medicago sativa* L. + *Dactylis glomerata* L.	6.2	27.3	5.1	32.0	20.4
Bunias orientalis L. + *Trifolium pratense* L. + *Bromopsis inermis* Holub	5.4	26.4	5.9	32.0	19.0
Bunias orientalis L. + *Trifolium pratense* L. + *Dactylis glomerata* L.	6.4	28.0	5.1	30.0	18.8
Cross-sowing					
Bunias orientalis L. + *Galega orientalis* L.	3.1	33.6	6.1	35.6	14.6
Bunias orientalis L. + *Medicago sativa* L.	4.6	26.2	7.2	34.0	15.0
Bunias orientalis L. + *Trifolium pratense* L.	5.6	31.4	3.3	33.2	14.4
Bunias orientalis L. + *Dactylis glomerata* L.	2.3	20.5	4.6	25.6	12.6
Bunias orientalis L. + *Bromopsis inermis* Holub	2.2	19.1	3.9	24.8	11.7
Bunias orientalis L. + *Galega orientalis* L. + *Bromopsis inermis* Holub	2.9	33.7	5.9	40.5	18.6
Bunias orientalis L. + *Galega orientalis* L. + *Dactylis glomerata* L.	3.4	32.7	6.1	39.6	17.9
Bunias orientalis L. + *Medicago sativa* L. + *Bromopsis inermis* Holub	4.5	25.9	5.0	31.2	15.8
Bunias orientalis L. + *Medicago sativa* L. + *Dactylis glomerata* L.	5.2	28.1	5.0	31.5	16.0
Bunias orientalis L. + *Trifolium pratense* L. + *Bromopsis inermis* Holub	5.4	26.8	5.7	30.6	13.6
Bunias orientalis L. + *Trifolium pratense* L. + *Dactylis glomerata* L.	5.5	29.8	5.1	30.0	13.8
HCR_{05}	0.15	0.48	0.08	0.39	0.12
HCR_{05A}	0.04	0.15	0.02	0.12	0.04
HCR_{05B}	0.10	0.34	0.05	0.28	0.09

In 1st, 2nd, 3rd years, in the main mowing, the maximum yields were given by three-component mixtures of *Bunias orientalis* L. with *Galega orientalis* L. and bluegrass crops. In the second year, in ordinary crops, the yield of the *Bunias orientalis* L. + *Galega orientalis* L. + *Bromopsis inermis* Holub variant exceeded the average yield for factor A by 30% and by 29% by experience. In a mixture with a hedgehog - 25.3% and 24.4%, respectively. When cross-sowing, these mixtures yielded lower than in ordinary crops by 2.3 and 2.0 t/ha. The third year as a whole was more favorable and the yield for all options was higher on average by 30.7% in ordinary crops and by 15.7 in cross crops. In the third year, in ordinary crops, the yield of the *Bunias orientalis* L. + *Galega orientalis* L. + *Bromopsis inermis* Holub variant exceeded the average for factor A by 18.8%, according to experience by 25.4%, the mixture with a hedgehog, respectively -13.8% and 20.1%. In cross-crops, the first mixture had this indicator at the level of 25% and 18.1%, the second - 22.2% and 15.5%. The remaining mixtures were less productive, although they gave a quite stable crop.

The nutritional value of the feed is estimated by the content of the main nutrients in the dry mass in mixtures, % (Table 2).

Based on the studies, we can conclude that the methods of sowing herbs have a significant impact on the chemical composition of the feed. So, on average, over three years of grass life, the highest protein content was noted in ordinary crops (Table 2), with the exception of mixtures of *Bunias orientalis* L. with *Galega orientalis* L. and clover. The highest protein content was in the mix of *Bunias orientalis* L. and *Galega orientalis* L. (18.25%) with cross-sowing and floor; the mixture was the best with ordinary sowing (17.08%). In the first year of grass vegetation, the mixture of *Bunias orientalis* L. and *Galega orientalis* L. was less productive in comparison with the average by 0.18% in both cases. In the second year of grass vegetation, the mixture of *Bunias orientalis* L. and *Galega orientalis* L. at cross-sowing was 0.25% higher, and at ordinary lower by 0.18%. This year, cross sowing was generally more productive. In the third year of vegetation, these mixtures were the best and the method of sowing did not affect the nutritional value of the feed.

When comparing two-component crops with the content of one legume culture and three-component crops, we see a pattern: for row crops, the combined team is most favorable as the third component of the hedgehog, and for cross-sowing, the boneless beef (Table 2).

Table 2. Dynamics of the content of basic nutrients in the dry mass in mixtures, %

Variety	Protein	Fat	Fiber	Ash
Ordinary crops				
Bunias orientalis L. + *Galega orientalis* L.	17.08	2.11	25.08	8.22
Bunias orientalis L. + *Medicago sativa* L.	17.00	2.84	25.08	8.26
Bunias orientalis L. + *Trifolium pratense* L.	17.08	2.$7	24.23	7.50
Bunias orientalis L. + *Dactylis glomerata* L.	13.23	3.64	27.65	7.96
Bunias orientalis L. + *Bromopsis inermis* Holub	15.05	2.85	27.72	8.30
Bunias orientalis L. + *Galega orientalis* L. + *Bromopsis inermis* Holub	16.20	2.60	27.12	8.05
Bunias orientalis L. + *Galega orientalis* L. + *Dactylis glomerata* L.	16.40	2.01	26.53	7.21
Bunias orientalis L. + *Medicago sativa* L. + *Bromopsis inermis* Holub	15.38	1.85	27.22	9,48
Bunias orientalis L. + *Medicago sativa* L. + *Dactylis glomerata* L.	15.65	2.21	26.92	7,51
Bunias orientalis L. + *Trifolium pratense* L. + *Bromopsis inermis* Holub	15.10	2.09	25.55	9,40
Bunias orientalis L. + *Trifolium pratense* L. + *Dactylis glomerata* L.	15.63	2.28	26.23	9.53
Cross-sowing				
Bunias orientalis L. + *Galega orientalis* L.	18.25	2.25	24.87	7.98
Bunias orientalis L. + *Medicago sativa* L.	16.92	2.91	25.68	8.34
Bunias orientalis L. + *Trifolium pratense* L.	17.22	2.05	24.50	7.79
Bunias orientalis L. + *Dactylis glomerata* L.	12.58	3.33	24.07	11.57
Bunias orientalis L. + *Bromopsis inermis* Holub	11.88	2.97	27.30	7.94
Bunias orientalis L. + *Galega orientalis* L. + *Bromopsis inermis* Holub	15.87	2.66	27.08	8.84
Bunias orientalis L. + *Galega orientalis* L. + *Dactylis glomerata* L.	15.80	2.16	26.48	8.07
Bunias orientalis L. + *Medicago sativa* L. + *Bromopsis inermis* Holub	14.74	2.15	27.13	8.43
Bunias orientalis L. + *Medicago sativa* L. + *Dactylis glomerata* L.	14.67	2.21	26.52	8.32
Bunias orientalis L. + *Trifolium pratense* L. + *Bromopsis inermis* Holub	15.04	2.16	25.60	8.69
Bunias orientalis L. + *Trifolium pratense* L. + *Dactylis glomerata* L.	14.79	2.16	26.00	8.76

The percentage of fat in the mixtures ranges from 1.85% (*Bunias orientalis* L. + *Medicago sativa* L. + *Bromopsis inermis* Holub in the ordinary way of sowing) to 3.64% (*Bunias orientalis* L. + *Bromopsis inermis* Holub in the ordinary way of sowing). At the same time, a high fat content on average is observed in cross crops. The same pattern was preserved in the first year of the vegetation of the grass, here there is a pattern: more protein - less fat.

The percentage of fiber ranged from 24.25% to 27.72% in ordinary crops and from 24.07% to 27.30% in cross crops. In both cases, these were two-component crops. In the three-component crops in the first case, fiber contained from 25.55% to 27.22% in the second from 25.60% to 27.13%. At the same time, according to factor B (sowing method), ordinary crops were distinguished.

CONCLUSIONS

Thus, the proposed methodology for calculating the coefficient of biological activity and the coefficient of competitiveness (CR) allows to evaluate three-component agrocenoses with different methods of sowing.

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