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Analysis of the productivity of sown legume-grass stands depending on alfalfa content, biostimulant application and weather conditions

Abstract. Intensive arable farming based on monoculture cropping leads to soil erosion, loss of biodiversity, and chemical contamination. One approach to mitigating these negative effects involves diversifying agroecosystems through the use of mixed cropping, particularly legume-grass mixtures. Such systems contribute to improved soil fertility, increased yields, and enhanced crop resilience to biotic and abiotic stresses. However, limited awareness of the composition and effectiveness of these mixtures hinders their widespread adoption in agricultural practice. This study aimed to investigate the development of alfalfa-grass mixtures depending on alfalfa content and to identify the most productive variants suitable for the Right-Bank Forest-Steppe zone of Ukraine, capable of delivering high and stable yields over extended periods. The research was conducted in the Forest-Steppe of Ukraine during 2021-2023 within permanent crop rotations at the experimental field of the Agronomic Research Station of the National University of Life and Environmental Sciences of Ukraine, located in Pshenychne Village, Bila Tserkva District, Kyiv Region. Several variants of alfalfa-grass mixtures were tested, with alfalfa content ranging from 35% to 75% and with the application of biostimulants (biochar, humic extract). The experiment was conducted according to a multifactorial field trial design with four replications. The primary indicator for evaluation was the yield of the grass mixtures over a three-year period. The findings revealed that the most productive mixtures were those containing 65-75% alfalfa, achieving the highest yields in the range of 35-37.6%. The use of biostimulants contributed to increased productivity; however, excessive application of these substances could reduce yields. The highest yield was recorded in the second year of the experiment, which was attributed to increased plant viability and favourable weather conditions. The results confirmed that an optimal alfalfa-to-

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grass ratio within the mixture is a critical factor in achieving stable yields. The effectiveness of biostimulants was influenced by the composition of the mixture and the growing conditions. Cultivating alfalfa-grass mixtures with 65-75% alfalfa proved to be an effective strategy for enhancing forage yield and production stability. The application of biostimulants can further improve productivity, although their efficiency depends on specific environmental conditions. The findings can be used to optimise crop area structure and support the adoption of environmentally sustainable agricultural practices

Keywords: biodiversity; grass mixtures; yield; crop resilience

INTRODUCTION

Cultivation of monocultures under intensive arable farming systems has a detrimental impact on the environment, leading to soil erosion and degradation, chemical contamination, and loss of biodiversity. In contrast, intercropping in agroecosystems helps restore ecological stability, promotes biodiversity, enhances plant interactions, and supports natural regulatory mechanisms. Long-term studies conducted by X. Li *et al.* (2021) demonstrated a significant (average 22%) increase in yield and greater yield stability of cereal crops under intercropping compared with monocultures, along with improved soil fertility over time. These findings highlight the potential of intercropping to enhance productivity and long-term sustainability in agriculture. J. Timaeus *et al.* (2022) showed that the use of wheat variety mixtures and heterogeneous populations in organic arable farming improves grain quality, suppresses weeds, makes more efficient use of resources, increases yields, and reduces lodging, particularly under drought conditions and on poor soils. Notably, heterogeneous populations exhibited greater yield stability than pure-line varieties. A study by Ya. Chabaniuk *et al.* (2024) on the relationship between soybean yield and meteorological conditions underscored the importance of climatic factors in crop productivity. Additional strategies include the application of organic fertilisers and the cultivation of forage legumes in combination with cereals (Danso-Abbeam *et al.*, 2021).

According to Y. Zhu *et al.* (2022), intercropping wheat with forage legumes, compared with wheat monoculture, led to increased yields of grain protein and amino acids, as well as higher gliadin content. These positive effects were further enhanced under moderate levels of nitrogen fertilisation, demonstrating the potential of intercropping to simultaneously improve both the yield and quality of wheat grain. Similarly, A. Zymaroieva & O. Zhukov (2020) found that including legumes in mixtures with cereals resulted in higher grain protein concentration, improved grain yield, and greater yield stability. S. Li (2024) reported that this approach enhances drought resilience by altering the composition of soil microorganisms and improving resistance to both abiotic and biotic stress factors more effectively than sole cropping.

The productivity of intercrops depends on the species included in the mixture. H. Berghuijs *et al.* (2020) emphasised the importance of selecting compatible genotypes for intercropping. They developed a new model to simulate strip intercropping of cereals and legumes under conditions of limited nitrogen availability and sufficient moisture. This model enabled the identification of optimal combinations of agronomic practices and plant traits to achieve higher yields in intercropped systems compared with monocultures. Research by L. Burko *et al.* (2021) conducted in the Right-Bank Forest-Steppe of Ukraine demonstrated a significant increase in the productivity of sown meadow grasslands when alfalfa was included – both in pure stands and in legume-grass mixtures. This effect was particularly evident under conditions without mineral nitrogen application, where productivity increased by 1.8 to 3.0 times compared with grass-dominated stands.

The cultivation of low-protein forage is a major factor contributing to reduced feed production and protein imbalance. This applies particularly to pure stands of cereal forage grasses. Such monocultures are typically deficient in protein, macro- and micronutrients, and other essential nutrients, leading to overconsumption of feed and reduced livestock productivity (Xu *et al.*, 2020). Scientific research and practical experience in forage production indicate that high-yielding legumegrass mixtures represent a reliable source of nutritionally balanced and consistently high-quality forage. As a result, modern forage production requires that perennial grasses occupy at least 50% of the total sown area. However, these mixtures currently cover only limited areas, and their yields remain relatively low. The slow adoption of grass mixtures in agricultural production is largely due to limited awareness of their nutritional value and significant advantages over pure stands. It should be noted that current literature provides limited guidance on the formulation of highly productive legume-grass mixtures, both in general and for specific zones and regions. As a result, many grass mixtures that are developed and sown often fail to meet expectations. The cultivation of legume-grass mixtures holds considerable agronomic value. After harvesting, a substantial amount of organic residue remains in the soil, which improves its structure and fertility. Numerous researchers have emphasised that the yield, quality, and nutritional balance of grass stands depend on the proportion of legumes within the mixture. Moreover, these mixtures contribute to carbon sequestration and reduce nitrous oxide emissions (Li *et al*., 2020; Pulina *et al*., 2023).

This study aimed to investigate the development of alfalfa-grass mixtures depending on the proportion of alfalfa in the composition and to identify the most productive combinations for the Right-Bank Forest-Steppe zone of Ukraine, capable of delivering high and stable yields over an extended period.

MATERIALS AND METHODS

The experiment was established in 2020, and research was conducted between 2021 and 2023 in the Forest-Steppe zone of Ukraine. The study took place at the research laboratory of the Department of Forage Production, using the stationary crop rotations of the experimental field within the educational and research farm of the National University of Life and Environmental Sciences of Ukraine (NULES of Ukraine) Agronomic Research Station (ARS) in Pshenychne Village, Bila Tserkva District, Kyiv Region. The soil on the experimental site is a typical low-humus chernozem with coarse-silty, medium loam texture on carbonate loess. The experiment used four replications and a systematic arrangement of treatments. The total plot area was 100 $m^{2,}$ with an accounting area of 50 m^2.

The climatic conditions during the study period were marked by unstable moisture regimes and fluctuating temperatures. In 2021, spring precipitation was within the normal range; however, June and July experienced a moisture deficit, which affected yield. The year 2022 proved to be the most extreme, as a significant lack of rainfall during May-July, combined with high temperatures, led to reduced crop productivity. In 2023, soil moisture at the beginning of the growing season was adequate, compensating for the rainfall shortage in May-June, while moderately warm summer conditions supported good plant development. An analysis of the significance coefficients for weather anomalies confirmed that 2023 was the most favourable year, whereas 2022 was the least favourable. Irregular precipitation patterns and temperature fluctuations influenced yield formation – typical for regions with variable moisture availability. Overall, weather conditions during the study period were generally favourable for the growth and development of perennial grasses. The preceding crop consisted of post-harvest catch crops, specifically a vetch-oat mixture sown after spring barley. The alfalfa-grass mixtures were sown under a cover crop of oats, with the seeding rate of the cover crop reduced by 30%. The cover crop was harvested for forage at the early heading stage. The alfalfa-grass mixtures were sown using a Klen-1.2 seed drill.

A range of research methods was employed: the calculated-weight method was used to assess crop density, weed infestation, crop productivity, and yield structure; the morphophysiological method was used to determine plant biometric parameters; and the mathematical-statistical method (analysis of variance) was applied to evaluate the reliability of the field trial results. Agronomic practices for cultivating alfalfa-grass mixtures followed standard recommendations for the ForestSteppe zone, except for the experimental treatments under investigation. The stand was harvested at the heading stage of cereals and the budding stage of legumes. The field experiment was designed as a multifactorial split-plot trial. Each plot measured 15 m^2, and the experiment was replicated three times.

The experimental treatments were as follows:

T.1 – Control; T.2 – Biochar (250 kg/ha applied during primary tillage); T.3 – Humus extract (50 L/ha at 30 days after emergence (DAE) + + 50 L/ha at 60 DAE).

The control treatment involved standard soil cultivation and crop management without the use of any specialised technological inputs. This allowed for comparison with the other treatments and facilitated the evaluation of yield parameters and product quality under natural growing conditions.

Biochar is a form of charcoal produced through the thermal processing of biological materials. Its application to soil can improve structure, enhance water retention, increase organic carbon content, and contribute to mineral fertilisation. Biochar IDEALE (n.d.) is a highly active soil additive and an important component for improving soil fertility. Its main constituent is carbon (92-96%), accumulated in biomass processed through hydrothermal carbonisation. The product is manufactured by the Organic Farming Club.

Humus extract is an organic product derived from the processing of humified waste. This input can increase the soil's organic matter content and improve fertility.

Weather data were collected throughout the growing season based on meteorological reports (Meteopost, n.d.). The typicality of weather conditions was assessed using the method described by Yu. Manko, based on the coefficients of the significance of deviation (Cs), calculated as $Cs = x - \bar{x}/s$, where x is the value for the research year, $\bar{x}$ is the long-term average, and s is the standard deviation from the meteorological data variation series. The analysis of the productivity of sown legume-grass stands – depending on alfalfa content, the use of biostimulants, and weather conditions – was conducted following ethical standards for biological research, including those relating to plants, in line with the Ethical Code of the Scientist of Ukraine (National Academy of Sciences of Ukraine, 2009).

RESULTS AND DISCUSSION

The research findings indicated that the yield of the sown grass stands was significantly influenced not only by weather conditions but also by the proportion of alfalfa in the mixture. The highest yield was recorded in the second year of use when the plants exhibited the greatest vitality, the highest stand density, and substantial leaf area (Table 1). Four years of data revealed that the productivity of alfalfa-grass mixtures was largely determined by species composition, alfalfa proportion, application of biostimulants, and environmental conditions. The highest yields were recorded in mixtures containing 65-75% alfalfa, with an average yield of 33.0-33.4 t/ha. The maximum productivity (34.3 t/ha) was achieved in the variant with 75% alfalfa and without biostimulants, suggesting the effectiveness of this ratio for establishing highly productive forage stands. The high yield of the grass mixture at this level of legume content was largely due to alfalfa's strong nitrogen fixation capacity, which contributed positively to plant growth, development of the grass stands, and ultimately, to increased yield.

Table 1. Productivity of grass mixtures depending on their composition and the use of biostimulants, SD NULES of Ukraine Agronomic Research Station, 2021-2023, t/ha

Proportion of alfalfa in the grass mixture	Biostimulant	Yield by year			Average
		2021	2022	2023	
100%, Alfalfa (*Medicago sativa*)	No biostimulant (Control)	24.1	24.6	25.3	24.7
	Biochar	22.1	23.4	24.8	23.4
	Humus extract	27.4	28.1	26.3	27.3
100% grasses, Reed canary grass (*Phalaris arundinacea*) + Red fescue (*Festuca rubra* L.)	No biostimulant (Control)	25.1	23.7	23.2	24.0
	Biochar	26.3	25.1	24.7	25.4
	Humus extract	29.1	27.4	28.1	28.2

Table 1, Continued

Proportion of alfalfa in the grass mixture	Biostimulant	Yield by year			Average
		2021	2022	2023	
Alfalfa (*Medicago sativa*) (35%) + Reed canary grass (*Phalaris arundinacea*) + Red fescue (*Festuca rubra* L.) (65%)	No biostimulant (Control)	25.7	23.3	23	24.0
	Biochar	25.4	25.5	24	25.0
	Humus extract	27.3	25.8	25.5	26.2
Alfalfa (*Medicago sativa*) (45%) + Reed canary grass (*Phalaris arundinacea*) + Red fescue (*Festuca rubra* L.) (55%)	No biostimulant (Control)	27.3	26.5	25.1	26.3
	Biochar	27.7	27.2	26.5	27.1
	Humus extract	29.5	27.6	26.3	27.8
Alfalfa (*Medicago sativa*) (55%) + Reed canary grass (*Phalaris arundinacea*) + Red fescue (*Festuca rubra* L.) (45%)	No biostimulant (Control)	30.1	27.8	26.7	28.2
	Biochar	29.7	28.9	27.8	28.8
	Humus extract	28.8	28	27.7	28.2
Alfalfa (*Medicago sativa*) (65%) + Reed canary grass (*Phalaris arundinacea*) + Red fescue (*Festuca rubra* L.) (35%)	No biostimulant (Control)	33.8	33.3	32.1	33.1
	Biochar	32.8	32.4	31.5	32.2
	Humus extract	30.1	29.2	28.7	29.3
Alfalfa (*Medicago sativa*) (75%) + Reed canary grass (*Phalaris arundinacea*) + Red fescue (*Festuca rubra* L.) (55%)	No biostimulant (Control)	34.8	34.4	33.8	34.3
	Biochar	34.8	34.4	33.2	34.1
	Humus extract	31.7	29.5	28.6	29.9
LSD 0.95		1.52	1.47	1.43	

Note: LSD 0.95 – least significant difference at the 0.95 confidence level
Source: compiled by the authors

The use of biostimulants had a differentiated effect. The application of biochar resulted in a slight increase in yield, as indicated by the figure of 34.1 t/ha in the variant with 75% alfalfa. In contrast, humus extract led to a reduction in yield in some grass mixtures with a high proportion of alfalfa – 29.9 t/ha at 75% alfalfa – suggesting a potential disruption of the nutrient balance. Yield dynamics over the three years of the experiment showed that the highest yields were achieved in the second year of cultivation. Notably, in the variants with 65-75% alfalfa, yields in the second year reached 33.1-34.4 t/ha, exceeding those of the first and third years. Excessive use of biostimulants in some cases led to reduced yields, highlighting the need to optimise dosage depending on the composition of the grass mixture and the growing conditions. At the same time, the findings indicated that pure stands of either alfalfa or grasses produced lower yields and are not considered promising in grass stand cultivation. An analysis of the typical deviations in average daily air temperature and precipitation from long-term averages is presented in Tables 2 and 3. According to the method of Yu. Manko, the typology of weather conditions is as follows: values from 0 to 1 are considered close to normal; from 1 to 2, moderately significant; and greater than 2, approaching extreme weather conditions.

Table 2. Average monthly air temperature and assessment of deviation typology, SD NULES of Ukraine Agronomic Research Station, 2021-2023

Year	Months											
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Average monthly air temperature, °C												
2021	−2.5	−4.5	2.7	8.0	14.3	21.3	24.6	21.1	13.5	8.4	4.8	−1.5
2022	−1.3	1.8	2.6	8.1	14.6	21.7	20.8	22.3	12.7	10.6	3.1	−0.7
2023	−0.3	−0.2	4.8	9.6	16.0	19.6	21.5	23.8	18.8	11.4	4.1	0.7
Long-term average	−3.2	−2.3	2.5	10	15.8	19.5	21.3	20.4	14.9	8.6	2.6	−1.8

Table 2, Continued

Year	Months											
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Typology of air temperature deviations, 2021-2023												
2021	−0.08	0.24	−0.02	0.22	0.16	−0.19	−0.35	−0.08	0.15	0.02	−0.24	−0.03
2022	−0.20	−0.54	−0.62	−1.22	−1.91	−2.68	−2.58	−2.74	−1.71	−1.46	−0.68	−0.27
2023	−0.31	−0.32	−0.86	−1.38	−2.06	−2.45	−2.67	−2.90	−2.37	−1.57	−0.78	−0.42

Source: compiled by the authors

A slight increase in average daily air temperatures was observed in June and July compared with long-term averages, which had an adverse effect on flowering, as well as pod formation and filling in alfalfa. In terms of precipitation distribution, 2021 was relatively dry, with 454 mm of rainfall – 100 mm below the long-term average – representing a significant shortfall (−1.8) (Table 3). This moisture deficit negatively affected the subsequent growth and development of alfalfa plants and their ability to achieve optimal yield levels.

Table 3. Precipitation and typology of deviations, 2021-2023

Year	Months											
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
2021	40	48.5	21.5	23.7	95.3	34.9	45.6	56.1	16.8	0.6	20.2	50.8
2022	30.9	10.6	8.5	37.6	31.2	37	36.8	51.2	43.1	18	11.2	3.1
2023	18.3	21.6	33.4	82.5	5.2	79.6	116	18.4	6.6	64.2	89.1	61.4
Long-term average	28	30.7	34.2	39	83.5	95.4	81.9	28.2	26.6	33.9	26.2	46.3
Typology of precipitation deviations												
2021	−1.9	−3.3	1.0	0.7	−10.7	−1.1	−2.8	−4.5	1.8	4.4	1.24	−3.6
2022	−0.5	2.7	3.1	−1.5	−0.5	−1.4	−1.4	−3.7	−2.4	1.6	4.3	4.4
2023	1.5	1.0	−0.9	−8.7	3.6	−8.2	−14.0	1.5	3.4	−5.8	−9.7	−5.3

Source: compiled by the authors based on the data of Meteopost (n.d.)

As in the previous year of the study, the spring, autumn (in part), and winter periods of 2022 were characterised by a precipitation deficit. The annual reduction in rainfall was substantial, amounting to 235 mm, with a typology deviation of −3.1. The average monthly temperatures were also higher than the long-term averages. In 2023, a slight increase in precipitation was recorded, with a typology coefficient of 0.6. However, the distribution of rainfall was uneven, with minimal precipitation in May and September and the highest levels occurring in June and July.

Thus, in terms of moisture regime, the conditions in Kyiv Region correspond to an unstable level of water availability. At the same time, the initial availability of soil moisture is a crucial factor for alfalfa cultivation. If heavy rainfall occurs between March and April, sufficient to replenish the reserves of productive soil moisture, a subsequent deficit in May and June is unlikely to have a significant negative effect on crop productivity. In 2021, March differed considerably from the average in terms of rainfall, while April, May, and July saw precipitation levels close to the longterm norms. In contrast, June experienced significant deviations from the average values. Overall, multiyear studies have demonstrated that irregular rainfall distribution and extended periods of heat during the alfalfa growing season adversely affect its growth and productivity.

The research findings confirm that the soil and climatic conditions of the Right-Bank Forest-Steppe are favourable for cultivating high-yielding alfalfa-grass stands. The present study demonstrated that the proportion of alfalfa in the grass stand is a key factor influencing yield formation. The highest yields were obtained when alfalfa made up 65-75% of the grass mixture, without the use of fertilisers or with the application of phosphorus and potassium only. An important outcome of the study is that pure stands of either alfalfa or grasses produced lower yields compared with legume-grass mixtures. This aligns with findings indicating that mixed sowings of legumes and grasses provide higher productivity and improved forage composition compared with monocultures (Savchuk & Vyhovsky, 2019).

Moreover, the application of mineral fertilisers and biostimulants has a positive effect on both yield and the chemical composition of alfalfa-grass mixtures. Specifically, the study found that mineral fertilisers and stimulants enhance dry matter yield and improve the biochemical composition of the forage (Savchuk & Vyhovsky, 2019). These results support the conclusion that the use of biostimulants is effective in the cultivation of alfalfa-grass stands. It is also worth noting that liming the soil contributes to the improved productivity of legume-grass stands (Hetman & Danyliuk, 2024). Research by V. Kurhak *et al.* (2022) showed that lime application during pre-sowing cultivation or annual application of phosphorus and potassium fertilisers increased yield by 5-9%, while their combined use led to a 9-15% increase. This highlights the importance of an integrated fertilisation approach in the cultivation of alfalfa-grass mixtures.

Additional findings also confirm that an optimal ratio of alfalfa to grass components in forage grass mixtures contributes to increased yields and improved forage quality (Anil *et al.*, 1998). This is consistent with the conclusions of the present study, which found that alfalfa-grass mixtures with a balanced component ratio deliver high yields and enhanced nutritional value. Legume-grass mixtures significantly outperform pure grass stands in terms of protein content and amino acid composition. They produce more tender forage, in which carbohydrate and protein compounds, mineral salts, carotene, and other nutrients essential for animal health are well balanced. Such forage fully meets the physiological needs of livestock (Demidas *et al.*, 2013). The conclusions of this study align with those of other researchers, including G. Demidas *et al.* (2019) and U. Karbivska *et al.* (2020), and underscore the importance of an integrated approach to cultivating legume-grass stands. In summary, the findings confirm the effectiveness of growing legume-grass stands in the Right-Bank ForestSteppe of Ukraine. Optimal alfalfa content in the grass mixtures, along with the application of appropriate agronomic practices, mineral fertilisers, and biostimulants, are key factors in achieving high yields and improving forage quality.

CONCLUSIONS

The conducted research confirmed that the productivity of cultivated alfalfa-grass stands largely depends on their species composition, the proportion of alfalfa, the application of biostimulants, and the environmental growing conditions. The highest yields were recorded in the second year of use when the plants exhibited peak vitality, the highest stand density, and a substantial leaf surface area. This highlights the importance of considering the age-related dynamics of grass mixtures in forage production. The optimal component ratio in the mixtures was found to be an alfalfa content of 65-75%. Such mixtures delivered average yields ranging from 33.0 to 33.4 t/ha, with maximum productivity (34.3 t/ha) achieved in the variant containing 75% alfalfa without the use of biostimulants. This indicates the effectiveness of this proportion for establishing high-yielding forage stands. The high level of nitrogen fixation by alfalfa supported improved growth and development of the grass stand and increased yield without the need for additional nitrogen fertilisers.

The use of biostimulants showed a varied effect on the yield of the grass mixtures. Biochar contributed to a slight increase in productivity, whereas humic extract, in some cases, reduced yield – particularly in mixtures with a high proportion of alfalfa. This may be attributed to a disruption in soil nutrient balance or species-specific differences in fertiliser uptake. Therefore, the application of biostimulants requires further research to determine optimal dosages and assess their suitability under varying agroclimatic conditions.

The distribution of precipitation and temperature conditions had a significant impact on the productivity of the grass mixtures. The year 2021 was marked by a moisture deficit, which adversely affected the growth and development of alfalfa. Analysis of the weather conditions confirmed that uneven rainfall distribution and increased average monthly temperatures can substantially influence yields, particularly during critical stages of plant development. Under such conditions, it is important to consider not only the species composition of the grass stand but also the potential for applying additional agronomic practices to enhance crop resilience during dry periods.

The analysis of the obtained results aligns with other studies, confirming that mixed sowings of legumes and grasses provide higher yields and improved nutritional value of forage compared to monocultures. It was also found that the effectiveness of fertiliser use depends greatly on the component ratio in the mixture, and excessive application may not only fail to increase yield but may also reduce it. This highlights the need for further research into optimising fertilisation regimes and the use of biostimulants in alfalfa-grass mixtures. Future research in this area should involve a more detailed investigation of the long-term effects of weather conditions on the productivity of grass mixtures. It is also necessary to explore the potential for adjusting agronomic practices in response to changing climatic conditions. Further experiments should aim to determine the optimal types and dosages of biostimulants based on the composition of the grass mixtures.

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CONFLICT OF INTEREST

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Аналіз продуктивності сіяних бобово-злакових травостоїв залежно від насичення їх люцерною, застосування біостимуляторів і погодних умов

Анотація. Інтенсивне землеробство, засноване на монокультурних посівах, призводить до ерозії ґрунту, втрати біорізноманіття та хімічного забруднення. Одним зі способів мінімізації таких негативних наслідків є диверсифікація агроекосистем через використання змішаних культур, зокрема бобово-злакових травосумішок, які сприяють покращенню родючості ґрунту, підвищенню врожайності та стійкості посівів до біотичних й абіотичних стресів. Однак недостатня проінформованість про склад і ефективність таких травосумішок уповільнює їх широке впровадження в аграрне виробництво. Метою роботи було дослідження процесу формування люцерно-злакових травосумішок залежно від вмісту люцерни в їхньому складі та визначення найбільш продуктивних варіантів для зони Лісостепу Правобережної України, які здатні забезпечити високі й стабільні врожаї упродовж тривалого періоду. Дослідження проводилося в Лісостепу України впродовж 2021-2023 рр. на стаціонарних сівозмінах дослідного поля в навчально-дослідному господарстві Національного університету біоресурсів і природокористування України Агрономічної дослідної станції (с. Пшеничне, Білоцерківський район, Київська область). Випробувано кілька варіантів люцерно-злакових травосумішок із різною часткою люцерни (35-75 %) та застосуванням біостимуляторів (біочар, гумус екстракт). Експеримент проводився за схемою багатофакторного польового досліду з чотирикратною повторністю. Основним показником оцінки була врожайність травосумішок упродовж трьох років. Встановлено, що найбільш продуктивними були травосумішки з часткою люцерни в межах 65-75 %, що забезпечувало найвищу врожайність на рівні 35-37,6 %. Використання біостимуляторів сприяло підвищенню продуктивності, але надмірна кількість біологічних стимуляторів могла знижувати врожайність. Найвищу врожайність спостерігали на другий рік експерименту, що пов'язано зі збільшенням життєздатності рослин і сприятливими погодними умовами. Результати дослідження підтвердили, що оптимальне співвідношення люцерни і злаків у травосумішці є критичним чинником для досягнення стабільної врожайності. Ефективність біостимуляторів залежала від складу травосумішки та умов вирощування. Вирощування люцерно-злакових травосумішок із часткою люцерни 65-75 % є ефективним способом підвищення врожайності та стабільності кормовиробництва. Використання біостимуляторів може додатково покращити продуктивність, проте їх ефективність залежить від конкретних умов. Отримані результати можуть бути використані для оптимізації структури посівних площ та впровадження екологічно сталих методів ведення сільського господарства

Ключові слова: біорізноманіття; травосумішки; врожайність; стійкість посівів