

Influence of agricultural measures on ecobiomorphic structure and productivity of self-relative reliable ecosystems on the largest ground lands of forest land

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The purpose. Establish the regularities of the ecogenetic process of sudden renewal of zonally adapted and economically valuable grassland herbaceous ecological-biological systems with high self-repair ability and develop effective ways to accelerate their formation. **Methods.** Field, laboratory, functional-group methods analysis of grassy ecosystems. **Results.** The results of many years of fundamental research on the study of ecogenetic reproduction processes are highlighted on the former arable lands of zonally-adapted grassy ecological-biological systems with high self-repair ability and effective ways to accelerate their formation and improving their economic value. **Conclusions.** Spontaneous re-establishment of meadow lands on the former plowing lands is the cheapest, but long in time (10 – 15 years) and in the first 3 – 5 years at high weediness provides feed low quality. Starting crop of bean-cereal mixture eliminates the weed phase development of cenoses and provides on the background of no fertilizers in the first 3 years in 3.7, and on average for 10 years 2.3 times higher yield and significantly improves the quality of the feed compared with spontaneous re-establishment. Sowing at the initial stage of seed of wild species of grasses of local flora for 5 – 7 years accelerates the formation of stable and zonally adapted herbage with high self-healing ability.

Key words: *sudden recovery, eco-biomorphic structure of cenosis, productivity, feed value.*

<https://doi.org/10.31073/agrovisnyk201806-02>

In the system of urgent tasks to optimize the territorial-functional balance of modern agrolandscapes, which have in Ukraine the highest plowing in the world, with the aim of improving the ecological state of the place and the cessation or radical weakening of the manifestation of water and wind erosion of soils, and also the preservation of rivers from silt and contamination of their water resources by aggressive agrochemicals, so important is the problem of fundamental study of the resumption and effective functioning of landscape and stabilizing elements of agrarian territories that is grassland as well as protective forest planting.

Goal - to establish the regularities of the ecogenetic process of sudden resumption of zonally adapted and economical valuable grassland herbaceous ecological biological systems with high self-healing ability and develop effective ways to accelerate their formation.

Methods. Studies on this issue were conducted during 1987-2017 in the long-term monitoring experimental station of the NSC "Institute of Agriculture NAAS" to study the regularities of sudden targeting of former arable land on watershed gray forest light loamy soils with a humus content of 0-20 cm – 1,68%, alkaline hydrolysable nitrogen 8,3 mg, active forms of P₂O₅ – 15,8 mg, K₂O – 13,8 mg and hydrolytic acidity of 1,3 mg / eq. per 100 g of dry soil, pH - 5,6. The study of the influence of technological measures on the transformation processes of the ecological and biological structure of renewable cenoses and their productive qualities was carried out in small-scale experiments of the department of fodder production and meadow farming of the institute, which located near the monitoring station with similar environmental and soil conditions in the northern part of the right-bank Forest-Steppe (village Chabany, Kiev-Svyatoshinsky district, Kiev region).

At the initial stage in the time of laying down a stationary experiment in 1987, at the half rate of seed sowing from the recommended in the early spring, unscarredly was sowed a grass mixture, which consisted

of *Bromopsis inermis* (Leyss.) Holub, *Festuca pratensis* Huds и *Phleum pratense* L., but during the vegetative time seeds of wild-growing herbs obtained from the best ecologically associated local natural phytocenoses and obtained by us from the protected ecosystems "Mikhailovskaya virgin land " (Sumy region) and "Streltsovskaya steppe" (Streletsky, Lugansk region) were scattered manually over the area.

When seeding cenoses were created in small-scale experiments, in order to compare them with sudden resumption grass mixture was sown in early spring, unprotected, which consisted of *Bromopsis inermis* (Leyss.) Holub of varieties Vyshgorodskiy (12 kg/ha), *Festuca orientalis* (Hack.) V. Krecz. et Bobr. Dominika (8), *Phleum pratense* L. Vyshgorodskaya (4) and legume-cereals from the same cereals + *Medicago sativa* L. Vertus (10) и *Trifolium pratense* L. Marusya (2 kg / ha of seeds).

In studying the productive properties of phytocenoses and transformational changes in them and soils used the generally methods of conducting research in meadowland and soil science [1]. To clarify the biomorphic structure of plant communities and ecogenetic changes occurring in them under the influence of natural and anthropogenic factors functional group methods of analysis of grassy ecosystems based on the genetic and physiological responses of plant species to various factors of influence [2, 3].

Results of the research. It has been established [4, 5] that in soils of arable land even with prolonged intensive growing on them of agricultural crops, on 1 to 0-10 cm layer contains up to 30-40 thousand of growing seeds of wild-growing species of higher plants, the viability of which persists for many years and even decades (40 and even up to 80-90 years).

In most cases they belong to 25-40, sometimes even more kinds. So as our studies have shown, already in the first years after the removal of lands from cultivation in a sudden renewed herbage, there are about 50 plant species that belong to 40-43 genera, 13-14 families and 12-13 orders, the projective coverage reaches 58-60%. Over the years, in the process of ecogenesis, the number of species grows and already in 3-5 years is 68-69, and the total projective coverage reaches 71-73%. At the same time, in the grass stand for 4-5 years, the amount of low-value one- and two-year-old weeds is significantly reduced from 63-70% to 14-29%, and later up to 2-8% and the presence of perennial species of grasses of the local wild flora increases (Table 1). Although, at this time (5-7 years of self-renewal), there are still many long-rooted grass in the

Table 1 Biomorphic and economic characteristics of sporadic sudden renewed grass stands on former arable lands for 1987-2017.

Year of overgrowth	Number of species, pcs.	Projective coating %	The ratio of biological groups, %			Coefficient of destruction, Kd	The ratio of economic groups, %			Dry matter, t/ha	Feed units, t/ha	The content in a crop, %		Index of feed value, point *
			perennial s	annuals	biennials		cereals	beans	motley grass			сырого про-теина	сырой клетчатки	
1	45	58	37	40	23	98	35	+	65	4,0	2,18	14,2	27,5	2,7
2	57	41	30	46	24	94	44	+	56	4,3	2,85	18,0	24,4	2,7
3	69	73	39	19	42	82	30	+	70	6,0	3,96	18,1	26,4	2,5
4	55	57	71	2	27	56	58	+	42	4,7	2,76	16,9	24,8	2,7
5	68	71	86	3	11	31	64	2	34	7,8	4,26	15,0	28,3	3,5
10	52	78	97	1	2	9	79	2	19	6,1	3,18	14,3	27,4	3,5
15	71	83	91	3	6	13	62	6	32	5,0	2,51	12,2	30,1	3,5
20	95	74	97	1	2	9	74	3	23	5,7	3,47	14,6	27,9	4,7
25	81	81	93	2	5	14	59	5	36	5,5	3,51	13,5	28,5	4,0
30	96	96	94	5	1	12	44	18	38	6,0	3,95	15,0	28,1	4,6
HIP₀₅ , t/ha										0,31	0,17			

Note. Index of feed value in points: 8 - the highest, 7 - high, 6 - high enough, 5 - good, 4 - medium, 3 - low enough, 2 - low, 1 - very low, 0 - do not have fodder value, harmful, -1 - poisonous.

herbages (*Elytrigia repens* (L.) Nevski, *Calamagrostis epigelos* (L.) Roth. and etc.), which indicates the incompleteness of ecogenesis, in their composition, a significant presence already consists of short-cornified and not densely-bush species (*Dactylis glomerata* L., *Poa angustifolia* L., *Festuca pratensis* Huds., *Arrhenatherum elatius* (L.) J. et C. Presl. and etc.), with a certain admixture of densely clustered grass *Festuca valesiaca* Gaud and rod-root plants with the presence in the lower part of their stems of lignified parts - caudex with renewal buds. The presence of the last group of plants indicates already a sufficiently high level of adaptation of plant communities to local conditions of growth with unstable moistening of soils and their approximation behind the ecobiomorphic structure to the xerophytic natural grassy ecosystems of the investigated zone.

With time the economic value of sudden renewed grass stands is improving.

In them participation increases of long-term cereals from 35% at the initial stage of overgrowth up to 64% at year 5 and the participation of herbs varied from 65 to 34 and at such a level with certain fluctuations over the years (within 19-38%) it was retained in subsequent years with a small (within 3-8%) presence of legumes. Productivity in most years increased from 4.0 t / ha to 5.0-7.8 t / ha dry matter and feed quality improved. The index of feed value increased from 2.5-2.7 to 4.0-4.7 points, that is, from low and fairly low to medium, and often good (Table 1).

At the same time, significant changes occurred in the process of adaptive phytocoenogenesis also in the ecological structure of self-renewing grass stands and associated soil environment.

With a predominance (up to 45-49% behind the projective coating) at the beginning of mesophyte formation (*Phleum pratense* L., *Festuca pratensis* Huds., *Trifolium repens* L.), that is, typical elements of meadow vegetation, then already at 5-7 years of overgrowing the vegetation cover consisted of 63-71% of xeromesophytes (*Poa angustifolia* L., *Filipendula vulgaris* Moench., *Vicia tenuifolia* L., *Campanula persicifolia* L. and etc.) and up to 11-12% from xerophytes, that is, steppe elements (*Festuca valesiaca* Gaud, *Astragalus onobrychis* L., *Hieracium pilosella* L. and etc.) with a decrease in the first group (mesophytes) to 5-8%. This indicates that in these environmental conditions the geochemical circulation of substances and energy occurs behind the meadow-steppe type and the gradual formation here of the hydro-mezoric-grass meadow steppes or at least steppe meadows.

In comparison with the period of intensive processing and loosening (high aeration period), in soils when growing crops with increased biotic use in them of deposited organics and first of all humus as a result of an insufficient balance in the system of its "receipt-expenditure" flows, after the appearance of seasonal carburization at the beginning of the formation of the the bulk mass already in the third year decreased in the 0-20 cm soil layer from 1.65 g / cm³ to 1.4-1.45 g / cm³, and at 5-7 years, as well as related water permeability, air exchange and other indicators, have reached the balanced values, as much as possible approached to the 29-31 years' retreat and untouched natural ecosystems [6, 7].

In this layer of soil before the 7th year, the humus content increased from 1.48-1.64% to 1.81-2.0% and within the limits of these values it was practically retained in all subsequent years [8]. At the same time, the content of hydrolyzed nitrogen - from 71,0-72,0 in the first year and up to 100.0 mg / kg dry soil at the 28th year. Along with this, the rearrangement of the qualitative composition of humus was noted by changing the ratio of humic acids to fulvic acids – from 0,73 in the 6-th year to 0,97 at the 28th year and mineral nutrient fund of soil. In it there was an increase in fractions hard to reach to plants and gross forms of phosphorus, fixed potassium and total nitrogen, which indicates a gradual recovery of the basic components of soil fertility.

In the process of sudden renewal on gray forest soils, which are underlain at a depth of 176-200 cm by loess-like loam, that is, at an inaccessible depth for most plants of the cenosis, from the 19-20s of their formation a slight decrease in the absorbing complex, the amount of exchange cations from 13.6 to 11.0 mg-eq / 100 g of dry soil and the degree of saturation of SAC (soil-absorbing complex) with bases from 94,1 to 87,3% with a corresponding increase in exchangeable aluminum and hydrogen, exchange (pH of the salt extract from 5,8 to 5,2) and hydrolytic (from 1,1 to 2,7-3,2 mg -100 g of dry soil) of the acidity of the soil solution.

The composition of soil biota has increased the number of earthworms and microorganisms [9, 10] – their ecological trophic and functional groups, first of all amonifical immobilizers of mineral nitrogen, azotobacter, oligonitrofacers, cellulose-destroying, polysaccharides are synthesized acid-forming at a decrease in the conditions of high saturation of the biogenic layer of soil by living and dead remains of the root mass of plants or according to the expression of E. Pianque [11], “organized of ensembles substances and energy” microorganisms of the carbon cycle - pedotrophs, autochthonous actino- and mycomycetes, and a decrease in the intensity of consumption of the deposited organic matter of the soil, and first of all the activity of mineralization, and destruction of humus. During the years of research, soil toxicity decreased by 9.4%.

So, sudden renewal on former arable land, zone-adapted grassy ecological-biological ecosystems is a complex and dynamic process with the manifestation in it of many random factors of formation, which consists of a series of temporary determinately variable stages of overgrowth, each of which is characterized by a peculiar biomorphic and phytocenotic structure and a special state of biodiversity. Each previous stage is the preparatory stage and the main resource base for the next, and the species richness and functional balance of biological diversity is the determining indicator of its state and the energy potential of dynamism and the mechanisms for its realization.

But the production of high productivity with high economic value of products, as our studies have shown, is possible only when applied at the initial stage after extracting from the intensive cultivation of soil the seeding of the regionalized varieties for a given area of legume cereals or even cereal grass mixtures.

Such seeding of the legume-cereal mixture, with *Bromopsis inermis* (Leyss.) Holub, *Festuca orientalis* (Hack.) V. Krecz. et Bobr., *Phleum pratense* L., *Medicago sativa* L. и *Trifolium pratense* L., eliminating the weed phase of the development of cenosis, from the first year provides a high quality of feed, and on average for the first 3 years, as can be seen from Table 2, allows without the application of mineral fertilizers on gray forest soils to produce 6,71 t / ha of dry matter, and on the average for 10 years - 3,76 t / ha with the index of fodder value of cenoses of 6,2, that is, food of high quality. This is more, respectively, at 3,7; 2,4 and 1,8 times, and in comparison with cereal grass mixtures - in 2,3; 1,5 and 1,1 times.

Leguminous -cereal mixture on the background $P_{40}K_{70}$ in the first 3 years, on the collection of dry matter exceeded the grass sudden resumption in 1.7 and cereal by 1.2 times on the background $N_{90}P_{40}K_{70}$. In subsequent years the legume-cereal grass was inferior to other grass stands, fertilized with full mineral fertilizer.

Therefore, after a significant decrease in 3-4 years of using leguminous herbs in their composition, it is necessary to introduce nitrogen fertilizers. A similar regularity was observed in the collection of feed units and crude protein.

Table 2 The productivity and nutritional value of herbaceous cenoses with different methods of their renewal, t / ha, for 2008-2017 years

variant	Dry matter, by years of use			Average for 2008-2017 years			
	1-3	4-6	7-10	dry matter	feed units	raw protein	feed value, point
Without fertilizer							
Sudden resumption	1,80	1,79	1,48	1,60	1,42	0,22	3,5
Bean- Cereal mixtures	6,71	2,49	2,39	3,76	3,19	0,65	6,2
Cereal mixture	2,92	2,63	2,26	2,47	2,16	0,31	5,7
$N_{90}P_{40}K_{70}$*							
Sudden resumption	4,02	4,08	3,48	3,54	3,13	0,57	3,6
Bean- Cereal mixtures	7,02	2,54	2,51	3,98	3,25	0,70	6,2
Cereal mixture	5,90	4,68	5,18	5,23	4,45	0,79	6,0

Note. * - only leguminous herbage is added

Sowing at the initial stages of the renewal of herbaceous ecosystems of seeds of wild-growing herbs, collected during their ripening from zone-adapted multi-species natural phytocenoses from ecologically conjugated habitats, as our studies have shown, increases the yield from the first years only with the sudden resumption of cenoses, and with the initial seeding of legumes and cereal grass mixtures only after their natural depression, mainly from 5-6 years of their existence. But this means (for 5-7 years) in all cases significantly accelerates the process of adapting them to local conditions and the formation of multi-species and stable ecological-biological systems, biomorphically and in terms of productivity as close as possible to their best natural counterparts. This is especially important when renewing permanent herbaceous ecosystems in the soil and water protection zones of the hydrographic network, on protected areas or areas of formation of the national ecological network of Ukraine, According to the Law of the Supreme Council of Ukraine of September 21, 2000.

Conclusions

Sudden renewal on former arable lands, adapted grassy ecological and biological systems, is the cheapest, but also long (10-15 years) in time and at the initial stages of their ecogenesis (during the first 3-4, sometimes up to 5-7 years), as a result of the presence of a significant amount of weeds in them, ensures a low fodder value of phytocenoses.

When carrying out the seeding of the legume-cereal mixture from the regionalized herbs already from the first year of use, plant communities on the background of no fertilizers in 3.7, and on average for 10 years are 2.3 times higher than the productivity of cenoses of sudden renewal and provide high quality feed. The addition at the initial stage of the renewal of grass seed seeds in grass mixtures from ecologically compatible best multispecies natural cenoses has little effect on the increase in the productivity of cenoses, especially during the period of maximum manifestation of the life potential of sown herbs, but almost completely eliminates the appearance of the weed phase after natural dilution at 5-7 years of life of the latter and for 5-7 years accelerates the formation of zone-adapted ecological-biological systems with high self-healing ability and well-harmonized biodiversity.

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