УДК 633.2

V. Kurhak, Doctor of Agricultural Sciences, Professor
A. Bohovin, Doctor of Agricultural Sciences, Professor
NRC "INSTITUTE OF AGRICULTURE OF THE NAAS"

PRODUCTIVITY OF GRASSLAND IN A CHANGING CLIMATE

Climate warming, which began in the second half of XIX century, and with a certain intensity continues today, cannot but be reflected in the future on the structural and functional organization of grasslands and their productivity, as well as on strategic methods of their improvement.

Our 20-years long studies showed that phytocenosis respond to climate aridization through a significant decrease in performance even on low-lying meadows with a shallow (1-2 m below the ground) subterranean waters. In dry years, the productivity of most grass mixtures with a predominance in their composition mesophytes, when compared with their average annual productivity in all years of research in these conditions, decreased by 26%-36%. However, environmental and biological structure of cenosis in this type of habitat remained stable.

At the watershed habitat, where moisture is supplied only due to precipitation, more stringent conditions for grasses are formed due to the climate warming. This not only leads to poor performance, but also to changes in ecological and biological structure in terms of strengthening of cenosis xerophytization, hence the need to improve the range of perennial grasses and technologies for improvement and use of grasslands.

The article includes an analysis of modern methods to provide the Ukrainian grasslands with composition of species and varieties of perennial grasses. It also outlines the main directions of their improvement in accordance with the regional topoecological composition due to the climate warming.

Keywords: *ecological and biological structure of perennial grasses and phytocenosis, climate warming, productivity of grasslands.*

Climate warming, which according to number of authors (Bojchenko et. al., 2000; Bojchenko., 2008) began as far back as in the second half of the XIX century and with a certain exacerbation is continuing today, cannot but reflect on structural and functional characteristics of grasslands and on strategic approaches and grassland farming methods.

It is known that permanent grasses as founders of grassland phytocenosis are in the main tolerant to temperature lowering. But being extensive consumers of water, especially some varieties of grassland and marsh ecology (transpiration coefficient is more than 600 mm), they are very sensitive to moist shortage and under circumstances of its limited supply and limited mineral provision may rather quickly and intensively decrease yielding capacity, mitigate competitive ability and eventually disappear from herbage.

But in the wild owing to great variety of habitats and their typological inhomogeneity, the response to grasslands climate aridization through ecological and biological structure changes and permanent grasses phytocenosis efficiency as main accumulators of the sun energy and fodder suppliers, will be complex. It must be taken into account just now when planning scientific-research work on resource base formation and developing arrangements of their improvement and efficient usage.

Materials and methods. Long-term researches of climate influence on sown grassland herbage and ecological and biological structure of their phytocenosis were carried out in Kyiv district in different types of natural fodder-producing areas on state enterprises NNC “Institute of Soil Management NAAN” “Kopylovo” (Polissia zone) and “Chabany” (Forest-steppe zone). Meteorological conditions as the main herbage operative factor we evaluated on the base of actual data with the help of humidity factor (HF) for flat area conditions which were stated as the ratio between the sum of monthly average, seasonal and annual precipitations (P, mm) and evaporation opportunity (Eo, mm) for the same period by formula: HF = P : Eo (Rode, 1969; Travleev et. al., 1979). Evaporation opportunity was calculated by formula of M. M. Ivanov: Eo = 0,0018 (25 + t°)2 x (100 – a), where t^0 is the sum of monthly air temperature and, *a* is monthly average relative air humidity (Travleev et. al., 1979). When analyzing ecological and biological structure of phytocenosis and selected species we use generally accepted in ecology physiognomic and floristic-individualistic methods of their analysis (Bohovin, 2003).

Results and discussion. It is stated that on lowland meadows of Polissia and in other areas of the country with hydromorphic soils, where plant water supply derives not only from atmospheric precipitation but also from underground waters which most of the vegetation period are at deep not more than 1.5 m and plant roots even in dry periods of the season can reach capillary fringe, the yielding capacity of permanent grasses considerably declines in dry years and notably rises in wet years.

The last mentioned may to a certain degree be indicatory to the fact that permanent grasses even on fertile soil of that type and when mineral fertilizers are introduced but without water application in most cases cannot represent their yielding potential. However to receive high and stable annual productivity (10-12 tons per hectare of dry matter and more) they need water application, as researches suggested, at rate of 1200 – 1400 m 3/ha during vegetation period

Thus, in dry 1975 with annual humidity coefficient 0.43 (fig. 1), which by M. M. Ivanov’s scale (Shashko, 1967) approximates humidity conditions of steppe area and in certain periods of active vegetation in summer it approaches to the conditions of dry steppe and even semidesert steppe (HF 0.33), the yielding capacity of most of 5-component grass mixtures of district species was compared to annual indices for 10 years. It appears to decline by 26-36 % and only some of them, which mainly consist of species with xerophilous properties (*dactylis glomerata L., festuca orientalis (Hack.) etc.*), have a decrease by 1.0 – 8.4 % (table 1). In wet 1977 p. (HF = 1.34) the yielding capacity of all grass mixtures increased by 32-48 %. Greater alterations of herbage yielding capacity took place when they were used as pastures and lesser changes happened when they were used for hay. (table. 2).

Despite the weather dependant yield variations of lowland meadows that together with similar by humidity conditions and soil fertility flooded areas amount to 3 million hectares and adaptive changes of floristic composition of sown plant communities that take place spontaneously in the process of their evolution, the ecological essence of the last in time varies only slightly.

They consist as a rule of 65-70 % of mesophytes and hygromesophytes, which are plants that grow and germinate properly implementing their productive potential in conditions of stable middle and higher soil moisturizing. Integral part of xeromesophytes and mesoxerophytes is not more than 15-20 % and xerophytes that are plants of dry habitats (edificators of steppe flora) are practically absent there. Under optimal conditions of plant care and usage, yielding capacity of these grasslands may be kept high for a long time without resowing. (decades and even centuries).

It is clear that under conditions of climate aridization the part of xeromesophytes and mesoxerophytes, especially on calcareous soils in the presence of freely soluble salts and representatives of meadow-halophilic mix in plant groups will increase but in circumstances of predicted characteristics of climate changes (air temperature will get up by 2ºC) they will not obtain the decisive part on the given types of grasslands.

That is why the main inventory of technological developments of their improvement and usage worked out by scientists and acquired in the course of field experience during the last 2-3 decades, we think, will remain. But it is true that the choice of grass mixtures for sowing on such meadows will somehow be changed and emphasis will be made first of all on stress-tolerant of drought species such as *Dactylis glomerata L, Festuca orientalis Hack., Phalaroides arundinacea L.* and others which, as researches has shown, (table 1.) under circumstances of shallow occurrence of subsoil waters compared to main species of mesophyte varieties have less yield disappearance because of drought.

On watershed divide habitat where moisture supply of plants takes place only by means of precipitations, and humidity coefficient even in the northern part of Forest-Steppe and in the southern parts of Polissia in summer by M. M. Ivanov's scale (especially in the last years) during some summer months often corresponds to those in Steppe regions and in some short periods even to semidesert conditions, absolute majority of cultivated permanent grasses which are in production or recommended by State Registry of Plant Varieties which can be used in Ukraine on a large scale for 2010 (further called 'register') is non-durable under such circumstances.

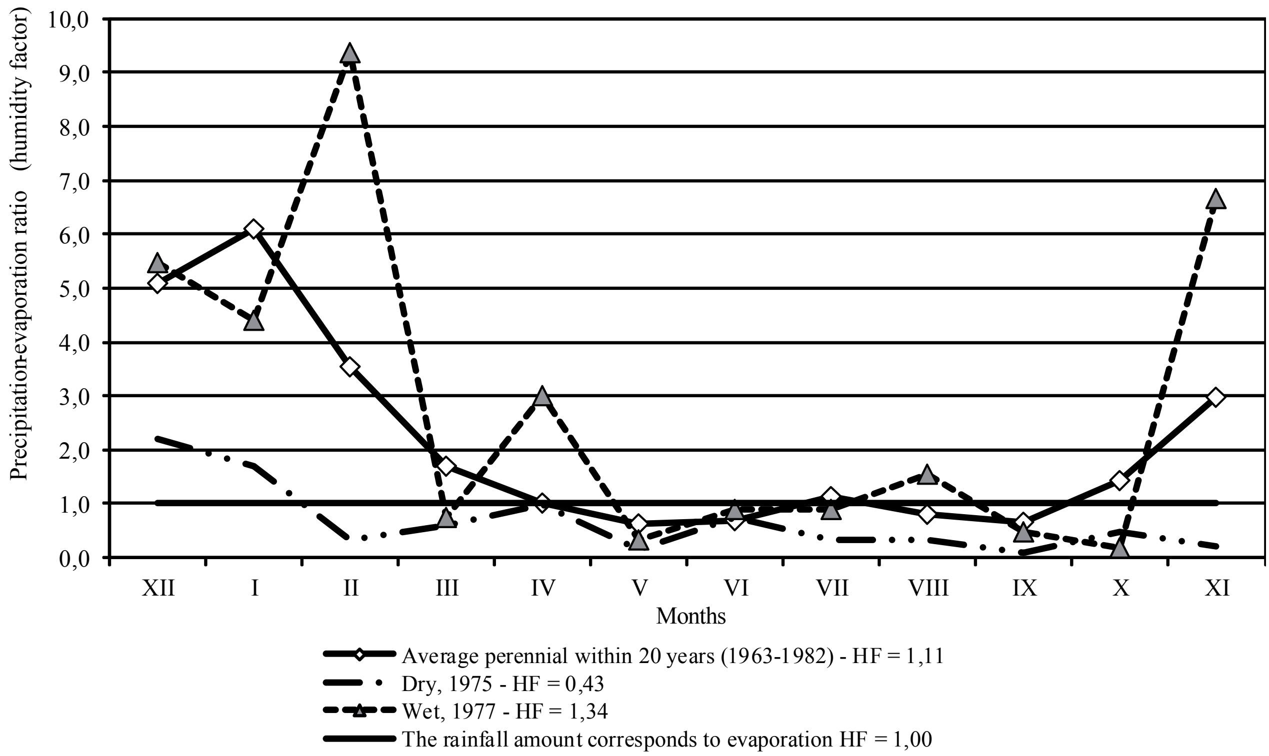

Fig. 1.

Monthly average humidity coefficients in different by humidity years (observations for 20-years period on meteorological station "Kopylovo").

Table 1.

Yielding capacity of herbages sown on lowland meadows of Polissia depending on humidity level in a year, t. ha⁻¹ of dry matter (1973-1982)

Main kind of grass mixture and sowing rate of seeds, kg ha^{-1}	Average yielding capacity for 10 years	including		± to annual yielding capacity			
		1975, dry year	1977, wet year	1975, dry year		1977, wet year	
				t.ha^{-1}	%	t.ha^{-1}	%
Alopecurus pratensis L., 15	5.30	4.21	7.45	-0.90	-26	+1.55	+41
Dactylis glomerata L., Kyiv early sowing 1, 17 variety	5.83	5.77	8.10	-0.06	-1	+2.27	+39
Dactylis glomerata L., Dedynivska 4, 17 variety	5.89	5.60	8.17	-0.29	-5	+2.28	+39
Lolium perenne L., 18	6.31	4.68	8.30	-1.63	-35	+1.99	+32
Festuca pratensis Huds., 17	5.93	4.37	8.78	-1.56	-36	+2.85	+48
Poa pratensis L., 15	6.17	4.72	8.86	-1.45	-31	+2.69	+44
Bromopsis inermis Leyss., 23	6.10	4.49	8.50	-1.61	-36	+2.40	+39
Phalaroides arundinacea L., 9	7.03	5.94	9.73	-1.09	-18	+2.70	+38
Festuca orientalis Hack., 17	6.83	6.30	9.88	-0.53	-8	+3.06	+45
Phleum pratense L., 12	6.49	5.12	9.14	-1.37	-27	+2.65	+41
Agrostis gigantean Roth., 10	7.03	6.05	9.78	-0.98	-16	+2.75	+39
Average for all mixtures	6.26	5.20	8.79	-1.06	-20	+2.53	+40
$HIP_{0.05}$, tons/ha	6.2	7.4	9.4				

Note. *The main variety in the mixture was supplemented by Trifolium pratense L., 3 kg + Trifolium repens L., 4 + Bromopsis inermis Leyss. 3 + Phleum pratense L., 2 kg/ha. In mixtures with predominance of Bromopsis inermis Leyss. or Bromopsis inermis Leyss. in supplementary group they were changed for Festuca pratensis Huds. Fertilizers background in 1973 $N_{60}P_{30}K_{60}$, з 1974 - $N_{120}P_{30}K_{60}$.*

Herbages composed of them (on poor soils in 2-3 years, on fertile soils in 5-6 years and sometimes more) become exhausted, weedy and in the process of further transformation gradually replaced by ever-present local species. On poor sod-podzolic soils of Polissia representatives of impoverished and cold soils are oligotrophicated, by definition of O. P. Shennikov (1941) and L.Y Afanasiev (1981) psychromesophytes (*Agrostis tenuis Sibth.*, *Luzula multiflora Retz.*, and *pallescens Sw.*, *Carex hirta L., Dianthus Borbasii Vandas* etc.) with certain admixture of silicophytes (acid soil plants) and drought-resistant varieties; in Forest-Steppe they are xerophylic varieties of grassland-steppe flora.

Exhaustion of herbages, even with a period of predominance of sown grasses in them and when adding the most fruitful legume and cereal varieties considerably decrease their yielding capacity. For example, in northern Forest-Steppe on light-grey forest sandy loamy soils the yield of dry matter was from 9.0-11.0 t ha^{-1} to 4.0-5.0 t ha^{-1} and on dusty sandy-clay sod-podzolic soils of Polissia it was from 6.0-7.0 to 1.5-2.5 t ha^{-1}. But later on together with spontaneous penetration of local varieties and recreation in the process of autoregulation of zone adapted phytocenocis, the yields again increased (accordingly to 6.0-8.0 і 3.0-3.5 t. ha^{-1} of dry matter), quality of fodder also increased.

Observations on sown plant groups transformations and first of all on their ecological structure which were being carried out for 20 years (1987-2007) in stationary field on research farm “Chabany” (Kyiv-Sviatoshin region of Kyiv district) on the same light-grey forest sandy loamy soils (0-20 cm layer contains 1.8% of humus; 10.6% of alkali hydrolyzed nitrogen; 14.2 mg of movable phosphorus, and 12.3 mg per 100 g of soil of exchangeable kalium, pHкcl – 5.4) showed that there was lowering from 52 to 3% of mesophytes, which were the main part of sown grasses, from the beginning of formation of sown alfalfa-cereal herbage to the 20th year. During all the period xeromesophytes keep the high level in the cenosis (39-48%) oreiginally represented by Lucerne, *Bromopsis inermis Leyss.* and then by *Bromopsis inermis Leyss., Poa angustifolia L., Galium verum L., Trifolium montanum L* and others. Eventually the amount of mesoxerophytes increased and there was a real increase of xerophytes (from 3 to 35%) that are elements of Steppe flora represented here mainly by *Festuca valesiaka Gaud.* (table 3).

Table 2.

Ways of usage affect on Polissia lowland herbages productivity in different moisture supply years, t ha^{-1} of dry matter

Average productivity for 1973-1982	from them in years		± to annual productivity			
	1975, dry year	1977, wet year	1975, dry year		1977, wet year	
			t ha^{-1}	%	t ha^{-1}	%
Grassland usage						
5.21	4.09	7.35	-1.12	-27	+2.14	+41
Hay usage						
7.86	6.92	10.27	-0.94	-14	+2.41	+31

Note. *Data are given for 2 grass mixtures in average.*

Table 3.

Varieties distribution according to ecological plant groups with regard to their water supply, % of total phytocenosis projective cover

Hygromorfe	Years of phytocenosis usage					
	1-st	2-nd	3-rd	7-th	14-th	20-th
Xerophytes	–	5	4	2	8	45
Mesoxerophytes	3	8	12	14	19	4
Xeromesophytes	43	41	41	39	40	48
Mesophytes	52	41	41	41	27	3
Hygromesophytes	2	3	2	4	6	+
Mesohygrophytes	–	2	–	–	–	–

Further climate warming on flat lands in all areas will contribute to formation of stricter growth conditions comparing to existing situation. In particular, xerophytism will increase in Forest-Steppe on account of drought-resistant varieties partiality rise (mesoxerophytes and xerophytes). On lowland meadows and flooded areas especially of small rivers in the southern part of Forest-Steppe zone and in Steppe the part of salt-affected soils will increase with their further salting. It will determine the need of certain reorientation in choice of technological approaches to their improvement and permanent grasses assortment formation and selection of grass mixes for sowing.

Ecological analysis of species and varieties structure of permanent grasses used for fodder and included to the Plant Varieties Registry of Ukraine (2010) by State Service of Protection of Rights for Plant Varieties in 2010 (table 5) shows that azonal and intrazonal areas (lowland, flooded meadows and innings) and also properly moisturized binder soil flat lands of western regions and sometimes of northern Forest-Steppe and Polissia areas where mesophyte conditions for plant existence prevail, are best supplied by plant kinds and varieties

Mesophyte group that is represented in the Registry by 18 varieties *(Festuca pratensis Huds., Festuca orientalis Hack. (arundinacea), Festuca rubra L., Festuca ovina L., Phleum pratense L., Lolium perenne L., Lolium multiflorum Lam., Agrostis gigantean Roth., Elytrigia elongata Host, Trifolium pratense L., Trifolium hybridum L., Trifolium repens L., Lotus ucrainicus Klok, Medicago lupulina L., Lathyrus sylvestris L., Galega officinalis L.* and others) and by 85 kinds, 55 % of all kinds and 54 % varieties in Ukraine included to the Registry fall in its lot.

Xeromesophytes are also adequately represented in it: (*Festuca orientalis Hack., Arrhenatherum elatius L., Elytrigia intermedia L., Bromopsis inermis Leyss., Dactylis glomerata L., Trifolium, Medicago sativa L., Medicago falcate L., Medicago varia T. Martyn, Melilotus album Medik.* And others). This ecological group may be successfully used for sowing on steppificated grasslands and even on moderately dry Steppe grasslands. It contains 10 kinds and 64 varieties which makes accordingly 32 and 41 % of their total number. Some regions are less supplied by moisture, namely watershed flat and steep grasslands, 8-10 million of hectares of low-yielding slopes and somewhere of flat arable lands being added, by valuation assumption their area will increase in Polissia from 0,15 to 0,85 million hectares, in Forest-Steppe accordingly from 0.5 to 3.2 million hectares and in Steppe from 1.7 to 5.8. Those areas are less supplied with kinds and varieties of grasses which are most suitable for them. Xerophytes and mesoxerophytes in the Registry of permanent grasses varieties are represented only by one specie of a sainfoin and accordingly by 4 and 2 varieties, and group of grassland-halophilic species of grasses which are the best for sowing on lowland, flooded and hearth lands

Table 4.

Ecological structure of permanent grasses kind and their varieties included in the Registry of plant varieties for 2010

Ecological plant groups, kinds and varieties	Ukraine		Polissia		Forest-Steppe		Steppe	
	Quantity of a species	%	Quantity of a species	%	Quantity of a species	%	Quantity of a species	%
Xerophytes								
from them: kinds	1	3	1	4	1	3	1	5
varieties	4	2	1	1	3	2	4	7
Mesoxerophytes								
from them: kinds	1	3	–	–	1	3	1	5
varieties	2	1	–	–	1	1	2	3
Xeromesophytes								
from them: kinds	10	32	9	32	10	34	10	45
varieties	64	41	33	27	46	37	41	68
Mesophyte								
from them: kinds	18	56	16	57	15	53	10	45
varieties	85	54	84	70	72	58	13	22
Hygromesophytes								
from them: kinds	2	6	2	7	2	7	–	–
varieties	3	2	3	2	3	2	–	–
Total amount of kinds	32	100	28	100	29	100	22	100
Total amount of varieties	158	100	121	100	125	100	60	100

Note. % is given to all amount of kinds or varieties.

with salty soils are represented practically by one kind, namely by wheatgrass (one variety).

Such a state requires introduction of certain corrections to the course of activity on enlargement of kind and variety assortment of permanent grasses in Ukraine considering both changes of grassland typological structure due to land reserves transformation and their ecological state in view of climate warming. Actual activity must be carried out introducing and attracting new advanced permanent grasses adapted to extreme environmental conditions of wild flora, in the first place representatives of violent group that are capable to stable domination in cenosis and patient (stress-tolerant) group that are competitive to 'strong' kinds and are suitable to form stable multispecies cenosis with high yielding capacity and long-term period of exploitation with high renewable ability. Among them a special attention should be paid to such kinds of grasses as Festuca valesiaca Gaud. and rupicola Heuff., Agropyron pectinatum Bieb. and *desertorum Fishc., Roegneria trachycaulon Link, Psathyrostachys juncea Fichs.*, some kinds of *astragalus, Medicago romanica Prod.* and for salted meadows *Elytrigia pseudocaesia Pacz., Elytrigia elongata Host., Puccinellia distans Jacq., bilykiana Klok., fomini Bilyk, bilykiana Klok* and others which are suitable for watershed areas with natural humidification.

Selection activity must be dedicated to newly introduced and traditional kinds of grasses in the course of rising their yielding capacity, plant matter forage value, creation of edaphic cenotype ecotypes, kinds with different rythmology of regrowth during the whole vegetative period for herbages of different farm purposes etc. Along with it growing technologies also demand certain corrections

Conclusions. Topoecological analysis of grasslands and peculiarities of permanent grasses growth and evolution and phytocenosis formation on them makes it possible not only to specify considerably modern strategic approaches to selection and seed growing and to development of technologies for efficient utilization of above mentioned lands but to forecast conclusions concerning their improvement in future in the context of climate changes, namely its warming.

Bibliography

1. Afanasiev D.J., Likhobabina E.P. and others. Natural Grassland sog Ukrainian Polissia. – K.: Naukova Dumka, 1981. – 302 p.

2. Bohovin A.V. Ecological Analysis of Plant Natural Biogeocenosis (physiognomic and florist-individualistic aspects of analysis in ecologyї // Ecology and noospherology. – 2003. V. 13. – № 1-2. – P. 4-11.

3. Bojchenko S.G., Voloshchuk M.V., DoroshenkoI.A. Global Warming and its Consequences on the Territory of Ukraine // Ukrainian Geographical Jouranal, №3. – K., 2000 – P.59-68.

4. Bojchenko S.G., Modern Global Climate Changes and their Consequences on the Territory of Ukraine // Svitogljad, №1. – K., 2008 – P.15-25.

5. State Registry of Plants Varieties Suitable for Distribution in Ukraine in 2010 . – Kiev : Alepha, 2010. – 246 p.

6. Rode A.A. Foundations of Soil Moisture Science. – L.: Hydrometeoizdat, 1969. – 287p.

7. Travleev L.P., Travleev A.P. Geobotanic's Guide on Soil Science and Hydrology:manual. – Dnepropetrovsk: Publishing house DSU, 1979. – 85 p.

8. Shashko D.I. Agroecological Regional Assignment of the USSR. – M.: Kolos, 1967. – 335 p.

9. Shennikov A.P..Grassland Science. – L.: Publishing house of Leningrad University, 1941. – 511p.

References

1. Afanasyev, D.Ya & Lykhobabina, E.P.(1981). Pryrodni luchni uhiddya Ukrayinskoho Polissya., Nauk. dumka, 302.

2. Bohovin, A.V.(2003). Ekolohichnyy analiz roslynnosti pryrodnykh bioheotsenoziv (fiziohnomichni ta florystyko-individualistychni aspekty analizu v ekolohiyi), Ekolohiya ta noosferolohiya., 13(1-2) 4-11.

3. Boychenko, S.H., Voloshchuk, M.V &, Doroshenko, I.A.(2000). Hlobal'ne poteplinnya ta yoho naslidky na terytoriyi Ukrayiny, Ukrayins'kyy heohrafichnyy zhurnal, 3, 59-68.

4. Boychenko, S.H.(2008). Suchasni hlobal'ni zminy klimatu ta proyavy yikh na terytoriyi Ukrayiny, Svitohlyad, 1, 15-25.

5. Derzhavnyy reyestr sortiv roslyn prydatnykh dlya poshyrennya v Ukrayini u 2010 rotsi.(2010)., Alefa, 246

6. Rode ,A.A. (1969). Osnovy uchenija o pochvennoj vlage., Gidromeoizdat, 287.

7. Travleev, L.P. & Travleev A.P. (1979). Sputnik geobotanika po pochvovedeniju i gidrologii: uchebnoe posobie., Dnepropetrovsk: Izd-vo DGU.

8. Shashko, D.I. (1967). Agroekologicheskoe rajonirovanie SSSR., Kolos.

9. Shennikov A.P.(1941). Lugovedenie. Izd-vo Leningradskogo un-ta, 511.

Кургак В.Г., Боговін А.В.

Продуктивність лукопасовищних угідь в умовах змін клімату

Потепління клімату, яке почалося ще у другій половині XIX століття, і з певною інтенсивністю продовжується тепер, не може не відбитись в майбутньому на структурно-функціональній організації лукопасовищних угідь і їх продуктивності, а також стратегічних методах їх поліпшення.

20-ти річні наші дослідження показали, що на аридизацію клімату значним зниженням продуктивності фітоценози реагують навіть на низинних луках з близьким заляганням (1-2 м від поверхні грунту) грунтових вод. В посушливі роки продуктивність більшості травосумішей з перевагою в їхньому складі мезофітів порівняно із середньорічною їх продуктивністю за всі роки досліджень в цих умовах знизилась на 26-36 %. Проте еколого-біологічна структура ценозів на даному типі місцезростань залишилась стабільною.

На вододільних місцезростаннях де вологозабезпечення відбувається лише за рахунок атмосферних опадів, за потепління клімату формуються жорсткіші умови для трав. Це призводить не тільки до зниження продуктивності, а й зміни еколого-біологічної структури у напрямі посилення ксерофітизації ценозів, що обумовлює необхідність удосконалення асортименту багаторічних трав і технологій поліпшення та використання лучних угідь.

У статті зроблено аналіз сучасного забезпечення лукопасовищних угідь України видовим і сортовим складом багаторічних трав, окреслені основні напрями їх поліпшення відповідно до регіонального топоекологічного складу у звязку з потеплінням клімату.

Ключові слова: *еколого-біологічна структура багаторічних трав і фітоценозів, потепління клімату, продуктивність лукопасовищних угідь.*

Кургак В.Г., Боговин А.В.

Производительность лугопастбищных угодий в условиях изменений климата

Потепление климата, которое началось еще во второй половине XIX века, и с определенной интенсивностью продолжается теперь не может не отразиться в будущем на структурно-функциональной организации лугопасовищних угодий и их производительности, а также стратегических методах их улучшения.

20-ти летние наши исследования показали, что на аридизации климата значительным снижением производительности фитоценоз реагируют даже на низменных лугах с близким залеганием (1-2 м от поверхности почвы) грунтовых вод. В засушливые годы производительность большинства травосмесей с преобладанием в их составе мезофитов по сравнению со среднегодовой их продуктивности за все годы исследований в этих условиях снизилась на 26-36%. Однако эколого-биологическая структура ценозов на данном типе местообитаний осталась стабильной.

На водораздельных мисцезростаннях, где влагообеспеченности происходит только за счет атмосферных осадков, за потепление климата формируются жесткие условия для трав. Это приводит не только к снижению производительности, но и изменения эколого-биологической структуры в направлении усиления ксерофитизации *ценозов, что обусловливает необходимость совершенствования ассортимента многолетних трав и технологий улучшения и использования луговых угодий.*

В статье сделан анализ современного обеспечения лугопастбищных угодий Украины видовым и сортовым составами многолетних трав, очерчены основные направления их улучшения в соответствии с региональным топоэкологическим составом в связи с потеплением климата.

Ключевые слова: *эколого-биологическая структура многолетних трав и фитоценозов, потепление климата, производительность лугопастбищных угодий.*

Рецензенти
Демидась Г.І. – д. с.-г. н.
Корсун С.Г. – д. с.-г. н.
Стаття надійшла до редакції – 01.06.2016 р.