

Rizun E.M., Rizun V.B. Grey toad (*Bufo Bufo* L.) influence on guilds of herpetobiontic beetles

On example of trophic activity of the grey toad its influence upon guilds of herpetobiontic beetles were analized. Elimination of the herpetobiontic beetles by the grey toad does not exceed 1 % from their absolute number. It is experimentally set that amount of meal which a stomach and kishkivniku frogs has approximately answers them to day's ration. Particle by eliminovanikh toads during the season of gerpetobiontnikh tverdokriliikh, approximately, will make less than 1 %. Usually, it will change depending on the quantity of toads in biotopi, but in any case such change will not be substantial.

Keywords: *Bufo bufo*, Amphibia, Coleoptera, ecology.

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ВМІСТ МАКРОКОМПОНЕНТІВ У ТРАВІ *FESTULOLIUM BRAUNII* СОРТУ ФЕЛОПА, ВИРОЩЕНОЇ НА СУБСТРАТАХ ІЗ РІДКОЇ ЗОЛИ КАМ'ЯНОГО ВУГІЛЛЯ, ОСАДУ СТІЧНИХ ВОД, СОЛОМІ ТА ПРЕПАРАТУ ЕМ-1

Метою досліджень була оцінка фітомеліорації рідкої золи кам'яного вугілля у поєднанні з осадами стічних вод, соломною і препаратом активних мікроорганізмів (ЕМ-1). Базуючись на результатах дворічного експерименту з *Festulolium braunii* var. Felopa, проаналізовано її врожайність та вміст калію, кальцію, магнію, натрію в траві. Застосування активізуючих речовин, тобто препарату активних мікроорганізмів (ЕМ-1) та керамічного пилу (ЕМ-Х), не мало істотного впливу на обсяг врожайності трави у перший рік експерименту і незначно знизило врожайність сухої маси трави наступного року. Протягом усього вегетаційного періоду першого і другого років *Festulolium braunii* var. Felopa була придатною до зростання на золі самостійно. Поєднання рідкої золи з осадами і соломною збільшило кількість калію у *Festulolium braunii* var. Felopa. Вміст магнію в *Festulolium braunii* var. Felopa збільшився на субстратах, складених золою і органікою, а також препаратом ЕМ-1 і становив близько 4 г Mg кг⁻¹ у сухій масі.

Ключові слова: *Festulolium Braunii* var. Felopa, врожайність, макроеlementи

Introduction. *Festulolium braunii* is a breeding cross between festucas (meadow fescue) and *lolium* (Italian ryegrass), which in Polish nomenclature has been given species name *festulolium*. It is a high grass forming loose tufts, with extensive root system. At present, there are four varieties of *festulolium* in the Register of Cultivars: var. *Felopa* and var. *Sulino*, var. *Rekopen* and var. *Agula* [Staniak, 2007]. Typical feature of this plant is a high percentage of leaves in green mass compared to generative shoots. This is a perennial aggressive species, resistant to summer drought.

Fluid burning is the most effective and at the same time cheapest method to decrease nitrogen oxide emission by reducing burning temperature to 850°C. Such technological operations change chemical and phasal composition of waste material remaining in the process of thermal and electric power production. Since fluidal furnaces can burn low-quality fuel, produced ash, often considered as waste, differs significantly from "standard" one. Fluidal ash is a fine-grain dust composed mainly of spherical glass grains, obtained in the process of burning black coal, ha-

ving properties of puzzolana (volcanic ash). It consists mainly of SiO_2 and Al_2O_3 . The lack of organic matter or nitrogen is the reason for the fact that ash alone has no physical and chemical properties which are beneficial for plant growth. On the other hand, waste material has other properties: i.e. it contains some macro- and microcomponents, or has strong alkaline reaction, which can be effectively used in agriculture. Therefore, it seems to be justified to apply ash as neutralizing agent for acid soil, or as fertilizer. From the point of view of finance and quality the best effect can be achieved when mixing ash with other waste such as sludge.

Natural and agricultural usage of sludge formed during treatment of municipal and industrial wastewater, is the most effective way of sludge management. Municipal sludge can be produced at various stages of wastewater treatment and can become a significant source of organic matter in soil, its production growing every year. Chemical composition of sludge varies depending on its origin. Nitrogen present in sludge occurs mainly in organic compounds. Phosphorus content in sludge does not justify a necessity to apply phosphates. A small content of potassium comes from disposal of this component with treated water due to good solubility of potash salt. Bearing in mind sludge greasy form and unpleasant smell it is recommended to apply it with straw or sawdust of conifers.

Wheat straw is a mature or dried plant stalk, with high content of dry mass (ca. 85 %) and high sorptive power. Being subject to gradual decay and mineralization during vegetation season it supplies plants with significant amounts of carbon dioxide. This compound has typical properties of ecological substratum. Application of straw as soil fertilizer in the form of manure or chaff enables formation of humus, a form of biological transformation.

EM is a biological vaccine of natural origin, which does not contain any GMO, and constituent microorganisms exist in natural environment worldwide. Effective Microorganisms (EM) are not only harmless for humans, animals and environment but also they are simply indispensable for normal functioning. The idea of Effective Microorganisms (EM) has been developed by Teruo Higa (Japan) in the eighties of the 20th century. It is a complex of living microbial cultures consisting of: yeasts, the order Actinomycetales, fermentation fungi, lactic acid bacteria and photosynthetic bacteria. Effective Microorganisms coexist and mutually develop; this phenomenon is called synergy principle. When EM are nourished they start to produce beneficial substances, e.g.: vitamins, organic acids and antioxidants. They regenerate soil microflora by introducing beneficial microbes to soil; thus reducing pathogenic processes and putrefaction of organic matter. Microorganisms exert antioxidant effect directly on soil and indirectly on plant, thanks to which ratio N: P: K and C: N stays uniform at satisfactory level, humus content is increased and produced food is of higher quality [Higa 2005]. Effective Microorganisms are sold in Poland under brand name EM-1, which is a concentrate containing over 80 various microbes. Effective Microorganisms Preparation (EM-1) is applied with ceramic powder being an agent for migrating effective organisms in soil. A particular property of ceramic powder EM-X is ability to absorb nitrogen compounds and other nutrients thus preventing washing out; it allows reduction of applied nitrogen fertilizers and decrease of component demand in soil. It has been

confirmed experimentally that application of ceramic EM-X and EM-1 generates decay of toxins present in soil and remnants of pesticides [www.vilamalia.com].

The aim of carried out studies was assessment of reclamation of black coal fluidal ash by combining it with digested sludge, straw and Effective Microorganisms preparation (EM-1). Based on results of 2-years-long experiment with *Festulolium Braunii* var. Felopa, the yield and content of following macrocomponents: potassium, calcium, magnesium and sodium in grass have been analysed.

Materials and methods

a) Conditions of conducting a potted experiment

In the years 2007-2008 a potted experiment with grass *Festulolium braunii* var. Felopa has been carried out in locality Dębina, West Pomeranian Province, Gryfin district, Stare Czarnowo commune. The experiment covered 8 fertilizing variants (Tab. 1.). The following substances have been used as activators of biochemical processes: Effective Microorganisms preparation (EM-1) in doses corresponding to 15 dm³/ha, and Ceramic Powder EM-X in dose 40dm³/ha. The experiment was set up by method of complete randomization in 4 repetitions. Soil used in the experiment was considered a light soil due to its granulometric composition. Fluidal ash was produced in Heat and Power Generating Plant (Elektrociepłownia Żerań). Sludge has been collected from rural sewage treatment plant after one year of open-air rest cure. Wheat straw was cultivated in preceding year.

Table 1. Number of fertilizing variant and applied fertilizer components

No of fertilizing variant	Applied fertilizers
1	Test – soil
2	Test – fluidal ash
3	Soil + sludge + straw – (4:2:1)
4	Fluidal ash + sludge + straw – (4:2:1)
5	Soil + sludge + straw (4:2:1) + Effective Microorganisms preparation (EM-1) [15 dm ³ /ha]
6	Fluidal ash + sludge + straw (4:2:1) + Effective Microorganisms preparation (EM-1) [15 dm ³ /ha]
7	Soil + sludge + straw (4:2:1) + preparation (EM-1) [15 dm ³ /ha] + Ceramic Powder EM-X [40 dm ³ /ha]
8	Fluidal ash + sludge + straw (4:2:1) + preparation (EM-1) [15 dm ³ /ha] + Ceramic Powder EM-X [40 dm ³ /ha]

The tested plant, a species *Festulolium* var. Felopa was sown to pots of volume 20 dm³ each (200 seeds per pot, corresponding to the amount 50 kg per hectare). *Festulolium* is a perennial grass 3-times cut. During experiment basic cultivation works were carried out according to agrotechnical principles. Automatic spraying has been applied in order to maintain standard humidity of soil in pots.

b) Chemical analysis methods

At the end of vegetation season cut grass was dried in temperature 105°C. In order to determine total content of mentioned above elements in plant, samples of analysed matter were mineralized in a mixture of nitric acid (V) and chlorous acid (VII), and next measured by means of atomic absorption spectrometer SOLA-ARS [Ostrowska et al., 1991].

To process obtained data concerning the yield, Tukey's confidence half-interval values were calculated, at significance level $\alpha=0.05$. Dry mass yield of *Festulolium* has been processed statistically by method of one-way variance analysis of complete randomization applying calculation software Analytical. Wariance. 4.1 created by F. Rudnicki. To compare with other results weighed averages were calculated.

Results and discussion

a) Yield of *Festulolium braunii* var. *Felopa*

In the present paper total dry mass yields of *Festulolium* obtained in subsequent years of the experiment have been compared (Tab. 2.).

In first year of the experiment the lowest dry mass yield was obtained for grass growing on substratum prepared of ash alone. The yield differed significantly from yields obtained from other fertilizing combinations (Tab. 2.). Test variant yield (soil substratum) was also low and differed considerably in relation to test yield of ash substratum and yield of other fertilizing variants with addition of sludge. Combination of soil or ash with sludge and straw resulted in significant growth of dry mass of grass *Festulolium* var. *Felopa*. The obtained yield was between 17.73 and 18.95 t·ha⁻¹. Addition of activating substances, as e.g. preparation EM-1 and Ceramic Powder EM-X did not influence significantly the volume of grass yield.

In the second year of the experiment total dry mass yield of *Festulolium* fell between 4.98 and 22.18 t/ha and remained at the level similar to first year data (Tab. 2.). Also in that year the lowest yield was obtained from grass growing on ash alone. However, it should be emphasized that grass was still able to grow on this substratum. Grass yield of soil test variant harvested in the second year of the experiment differed slightly from the yield of fertilizing variants in which sludge and straw were applied. However, the presence of activating substances, i.e. preparation EM-1 and Ceramic Powder EM-X, lowered a little dry mass yield of grass growing on these substrata (maximum value 5.68 t/ha) (Tab. 2.).

Table 2. Total dry mass yield of *Festulolium braunii* var. *Felopa* [t·ha⁻¹]

Years of experiment	Fertilizing variant								LSD _{0,05}
	1	2	3	4	5	6	7	8	
2007	9,98	2,50	18,95	17,93	18,35	17,73	18,83	18,13	0,761
2008	18,86	4,98	22,18	18,70	19,80	17,68	16,40	20,93	3,900

b) Content of macrocomponents in *Festulolium braunii* var. *Felopa*

Potassium. In the first year of the experiment grass growing on fluidal ash substratum had lower potassium content by ca 30 %. Application of organic fertilizers to soil did not have a significant effect on potassium content in *Festulolium braunii* var. *Felopa*. However, combination of ash with organic fertilizers was the reason for increased value of potassium in grass, stabilizing at the level 38 g K/kg of dry mass. In the second year of the experiment no diversification of available potassium in each fertilizing variant was discovered which was reflected in relatively uniform amount of potassium in cultivated grass. In the second year of experiment lower amount of potassium in grass has been observed compared to da-

ta in the first year of experiment; the content varied between 16.79 and 31.08 g K/kg of dry mass (table 3.).

Table 3. Weighed average contents of macrocomponents in grass

Years of experiment	Fertilizing variant								LSD _{0,05}	Normal content in the grass
	1	2	3	4	5	6	7	8		
Weighed average contents of potassium in grass [g K/kg s.m.]										
2007	38,12	29,60	34,12	38,07	42,01	36,29	37,39	37,60	3,85	6,0-83,5
2008	27,37	26,93	26,75	31,08	20,72	16,79	21,07	28,92	2,77	
Weighed average contents of calcium in grass [g Ca/kg s.m.]										
2007	4,79	5,52	4,62	3,56	4,16	5,02	4,56	3,32	0,49	1,0-43,5
2008	1,66	1,96	2,17	2,92	1,64	2,86	2,62	2,04	0,21	
Weighed average contents of magnesium in grass [g Mg/kg s.m.]										
2007	1,95	2,00	1,9	4,72	2,01	4,71	2,20	4,83	0,52	1,2-3,9
2008	1,60	1,88	1,78	2,07	1,83	2,41	2,15	2,00	0,16	
Weighed average contents of sodium in grass [g Na/kg s.m.]										
2007	0,17	0,25	0,49	2,63	0,33	2,85	0,63	2,71	0,10	1,5-5,5
2008	0,20	0,18	0,74	0,78	0,72	0,82	0,63	1,20	0,09	

Calcium. Festulolium cultivated on fluidal ash alone had the highest content of calcium (5.52 g Ca/kg of dry mass); addition of organic substance to substratum decreased calcium abundance in growing plants. In the second year of the experiment it has been observed considerable (ca 50 %) drop of total calcium in grass. Calcium content was between 1.64 and 2.92 g Ca/kg of dry mass and had typical value for grass (table 3.).

Magnesium. In the first year of the experiment Festulolium growing on fluidal ash substratum and on soil test variant had magnesium content ca 2 g Mg/kg of dry mass which corresponded to magnesium content in grass growing on other substrata containing soil. However, grass growing on substrata consisting of ash and organic substance as well as preparation EM-1, absorbed more magnesium (from 4.71 to 4.83 g Mg/kg of grass dry mass).

In the second year of the experiment total magnesium in grass significantly decreased and standardized. Magnesium content was from 1.60 to 2.41 g Ca/kg of dry mass and achieved values typical for grass (Tab. 3.).

Sodium. Combining ash and soil with organic fertilizers was the reason for considerable growth of the amount of sodium in grass. In both years of the experiment grass cultivated on substratum of fluidal ash combined with organic substance had higher content of total sodium (at the level of 2 g Na/kg of dry mass in first year and 0.7 Na/kg of dry mass in second year). Similarly as for other macrocomponents, in the second year of the experiment it achieved much lower value of sodium in Festulolium.

Conclusions. Combination of soil or ash with sludge and straw resulted in significant growth of dry mass of yield of Festulolium braunii var. Felopa, particularly in the first year of the experiment.

Application of activating substances, i.e. Effective Microorganisms preparation (EM-1) and Ceramic Powder EM-X did not have significant effect on the volume of grass yield in the first year of the experiment and decreased slightly the yield of grass dry mass in the second year.

During the whole vegetation season in first and second year *Festulolium braunii* var. *Felopa* was able to grow on ash alone.

Combination of fluidal ash with sludge and straw increased the amount of potassium in *Festulolium braunii* var. *Felopa*.

Festulolium cultivated on fluidal ash alone had the highest calcium content, while addition of organic substance to substratum decreased calcium abundance of growing plants.

Magnesium content of *Festulolium braunii* var. *Felopa* growing on substrata consisting of ash and organic matter as well as preparation EM-1 was ca 4 g Mg/kg of dry mass.

Combination of fluidal ash and soil with organic fertilizers increased considerably sodium content in grass.

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Гибчинская М., Хури Г., Романовски М., Юргель-Малецкая Г., Папротна И., Башуцкая У.Б. Содержание макрокомпонентов в траве *Festulolium Braunii* сорта фелопа, выращенной на субстратах из жидкой золы каменного угля, осадка стоковых вод, соломе и препарата ЭМ-1

Целью исследований была оценка фитомелиорации жидкой золы каменного угля в сочетании с осадками стоковых вод, соломой и препаратом активных микроорганизмов (ЭМ-1). Базируясь на результатах двухгодичного эксперимента из *Festulolium braunii* var. *Felopa*, проанализирована ее урожайность и содержание калия, кальция, магния, натрия в траве. Применение активизирующих веществ, то есть препарата активных микроорганизмов (ЭМ-1) и керамической пыли (ЕМ-Х), не имело существенного влияния на объем урожайности травы в первый год эксперимента и незначительно снизило урожайность сухой массы травы в следующем году. В течение всего вегетационного периода первого и второго годов *Festulolium braunii* var. *Felopa* была пригодной к росту на золе самостоятельно. Сочетание жидкой золы с осадками и соломой увеличило количество калия в *Festulolium braunii* var. *Felopa*. Содержание магния в *Festulolium braunii* var. *Felopa* увеличилось на субстратах, составленных золой и органикой, а также препаратом ЭМ-1 и составляло около 4 грамма Mg кг-1 в сухой массе.

Ключевые слова: *Festulolium Braunii* var. *Felopa*, урожайность, макроэлементы

Gibczyńska M., Hury G., Romanowski M., Jurgiel-Malecka G., Paprotna J., Bashutska U. Content of macrocomponents in grass *Festulolium Braunii* (braun's festulolium) var. felopa growing on substrata: black coal fluidal ash, sludge, straw and preparation EM-1

The aim of carried out studies was assessment of reclamation of black coal fluidal ash by combining it with digested sludge, straw and Effective Microorganisms preparation (EM-1). Based on results of 2-years-long experiment with *Festulolium braunii* var. Felopa, the yield and content of following macrocomponents: potassium, calcium, magnesium and sodium in grass have been analysed. Application of activating substances, i.e. Effective Microorganisms preparation (EM-1) and Ceramic Powder (EM-X) did not have significant effect on the volume of grass yield in the first year of the experiment and decreased slightly the yield of grass dry mass in the second year. During the whole vegetation season in first and second year *Festulolium braunii* var. Felopa was able to grow on ash alone. Combination of fluidal ash with sludge and straw increased the amount of potassium in *Festulolium braunii* var. Felopa. Magnesium content of *Festulolium braunii* var. Felopa growing on substrata consisting of ash and organic matter as well as preparation EM-1 was ca 4 g Mg/kg of dry mass.

Keywords: *Festulolium Braunii* var. Felopa, yield, macroelements

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**ОЦІНЮВАННЯ БІОТИЧНОЇ ПРОДУКЦІЇ СТОВБУРІВ ДЕРЕВ
ВІЛЬХИ КЛЕЙКОЇ У ЗАХІДНОМУ ПОЛІССІ**

Здійснено оцінювання продукції стовбурів дерев вільхи клейкої в досліджуваному регіоні. Наведено інформативні показники, які характеризують якісну структуру деревини та кори стовбурів дерев вільхи клейкої. Оцінено потенційні можливості цієї деревної породи у процесі стоку вуглецю з атмосфери. Встановлено, що оцінювання біотичної продукції дерев має багато спільного з давно опрацьованим у лісівництві та лісовій таксації вченням про поточний об'ємний приріст стовбурів дерев, який визначається в одиницях об'єму. Поточний об'ємний приріст стовбурів дерев вільхи клейкої у вагових одиницях і є їх річною продукцією.

Ключові слова: біотична продуктивність, продукція, фітомаса, поточний приріст, щільність, модельне дерево, тимчасова пробна площа, регресійні рівняння, коефіцієнт детермінації.

В умовах розвитку науково-технічного прогресу та інтенсивного росту населення світу лісові масиви і окремі лісові екосистеми набувають значення одного з найголовніших компонентів біосфери, які істотно впливають на глобальні екологічні процеси. Ліс як тип рослинності відіграє провідну роль в акумулюванні сонячної енергії в біотичному енергетичному потоці біосфери, у продукуванні кисню та у фіксуванні вуглекислого газу (CO₂), який виділяють різні джерела.

У сучасних умовах, коли на перший план висувається оцінювання функцій лісу як елемента біосфери та найдієвішого стабілізатора навколишнього середовища, треба очікувати ще більшого змикання завдань лісової науки, загальних екологічних і соціальних проблем. Тому головні розділи досліджень екосистем – біотична продуктивність лісів і циркуляція біогеохімічних процесів у біосфері – крім свого пізнавального і загальнотеоретичного зна-