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THE CULTIVATION OF LUCERNE ON MINERALIZED PEAT SOILS IN BELARUS

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Abstract

The data on efficiency of a lucerne (Medicago sativa) of the sowing campaign cultivated on the antropogenically transformed peat soils of Polesye with the content of organic substance of 13-26% and the level of ground waters more than 0.8 m are submitted. Productivity of lucerne herbage can reach depending on applied agro- and biotechnological methods. It is established that efficiency of a lucerne herbage can reach 56.8-87.9 centner feed units per hectare depending on the applied agrobioprocessing methods. At cultivation of a lucerne on such soils without cover culture (the doubled norm of seeding) more effective in comparison than under winter pea and oat mix. This mode provides an increasing of feed units per hectare by 13.8-26.1; digested protein content by 1.4-2.6 and exchangeable energy by 15.83- 30.61 GJ per hectare.

Key words**:** *antropogenically transformed peat soils, Belarus Polesye, lucerne, productivity, ways of sowing*

INTRODUCTION

At the high level of efficiency of animal husbandry and its further building the main problem of a forage production demanding the fastest decision is imbalance of forages on protein. The lack of fiber in diet leads to the over-expenditure of forages and in a consequence to rise in price of animal industries production. Because of not equation of fodder diets on a protein in daily fodder balance on 20 % the shortage of cattle-breeding production reaches 30-40 %, and its cost price and the expense of forages increase 1.5 times. On scientifically proved norms on one fodder unit should have digested protein in diets of cows – 102 r, growing young growth of large horned livestock (Cattle) – 107. Actually in republic the maintenance of digested protein in forages is 25-30 %, below the zootechnical norms.

To solve a problem of fodder fiber it is possible by realization of a complex of actions: introductions in manufacture new, high-yielding bean, including long-term, cultures; cultivating them on soils, before considered unsuitable for cropping of long-term bean grasses, for example, lucernes; perfection of technologies of cultivation and increase of productivity of bean cultures; optimization of structure of areas under crops with increase in relative density of the bean cultures giving the greatest exit of fiber.

It is possible to increase balance of own forages protein in the region by expanded of the areas under a lucerne on antropogenically transformed peat soils. The peat soils transformed in the course of agricultural use have favorable water-physical and agrochemical parameters [2, 6, 7] and now are suitable for lucerne [3, 4].

The aim of study – to prove and develop a complex of the agrotechnical processes allowing to cultivate a lucerne effectively for forage on the antropogenically transformed peat soils of Polesye.

MATERIALS AND METHODS

Researches were run in the period 2010-2012 on peat-mineral and mineral residual-peat soils on Soligorsk area of the Minsk region. The agrochemical characteristic of soils: OB 13.0-26.0 %, pH_{KCl} – 5, maintenance P_2O_5 ~ 271 mg/kg, K_2O ~ 644 mg/kg of soil, CuO ~ 0.6 and ZnO ~ 5.2 mg/kg of soil, groundwater levels (GWL) 1.0-1.2 m. Capacity of arable horizon of 0.25-0.35 m,

from depth is spread by sand.

In experiment it was used the lucerne cultivar Birute. The scheme included integumentary and uncoated sowing of a lucerne against $N_0P_0K_0$ (control), $P_{60}K_{90}$ and $P_{90}K_{90}$. In experience it was estimated the influence of various ways of preseeding processing of seeds: a mix ammonium molybdate (25 g per centner) and boric acid (25 g per centner) (trace elements (TE)) or effective immuno- and growth-enhancement a complex of connections triterpenoid acids (BAS). Seeds without processing by preparations sowed against a starting dose of nitrogen – N_{30}. For prevention of the diseases, all seeds before crops have been treated with fungicide (a. i. benomil, 500). Integumentary culture was winter pea and oat a mix with the reduced norm of seeding on 40 %. Lucerne under a cover sowed at norm of seeding 12 kg per hectares, uncoatedly – 25 kg per hectares [1]. In the first year (under integumentary culture 1 hay crop) and the life of a lucerne second years was spent by 2 hay crops, for the third year of a life – 3 in a budding phase – the flowering beginning.

Influence of various agrobioprocessing methods on productivity and efficiency of lucerne herbage estimated by the following criteria: to quantity of the truncated vegetative runaways in the beginning regrowth for the second and third years of a life of grasses; to botanical composition of herbage, its productivity and efficiency; economic efficiency of various receptions.

The weather conditions in a year of crops (2010) and the third year of a life of grasses were close to the average long-term values of region of Polesye. The weather conditions of 2011 were not typical and at the water mode have considerably affected herbage formation. So at the raised temperatures of May and June the shortage of deposits is noted. 2-3 decades of May and 1-2 decades of June were without rain, and their basic quantity has dropped out in the end of a month, having exceeded the norm of 29 mm. The rainfall in July was 2.1 times higher in comparison with average long-term values. In August and September an amount of precipitation in 1.2 and 1.6 exceeded norm. Regular rains during the season provided the constant level of ground waters (GWL) 0.95 m. The temperature slightly (on 2-3 ^oC) exceeded average long-term values. Thus, in 2011 the lucerne after the first hay crop because of a lack of moisture was in a rest stage a long time, a large amount of rainfall and GWL in the second half of summer only 2 hay crops allowed to promote.

For calculation of economic efficiency of cultivation of a lucerne technological cards in which considered expenses for all kinds of works, and also cost of fertilizers, seeds and means of chemicalixation for 2010-2012 have been made. Tables included following works: the basic and preseeding processing of soil, crops, care of crops, harvesting, transportation of the crushed weight to a consumption place, thus gave attention to amount of works, structure of the unit and its development, work expenses, the fuel expense, material requirements, and also to operational expenses. For an estimation of economic efficiency of cultivation of cultures the indicator conditional (settlement) profit, as financial result of the conditional fact of economic activities has been made, which can change (abstract hectare without soil characteristics, without the VAT, etc. taxes etc.) [5]. Haylage lucernes counted cost of fodder unit through cost of fodder unit of oats.

RESULTS AND DISCUSSIONS

Data of long-term researches with a sowing campaign lucerne on the antropogenically transformed mineral residual-peat and postpeat soils with maintenance OB less than 10 % prove, that these soils are suitable for cultivation of this bean culture [3, 4]. However working with the cultivation technology which includes ways of preseeding processing of seeds and sowing, a dose of fertilizers was necessary for its wider distribution to manufacture. For this purpose on the antropogenically transformed peat soils with organic substance maintenance about 20 % multifactorial field experience has been put in pawn.

The influence of various biotechnological methods is noted at all stages of formation of

efficiency. At uncoated sowing within the first year of life for more developed plants which in the beginning of the vegetative period of the second year of a life have formed in 1.12-1.51 times more than the truncated vegetative runaways in comparison with the plants developing under integumentary culture (tab. 1) were generated. Even on a variant without fertilizers the quantity of runaways of a lucerne was on 140 pieces/m^2 more than sown under a cover winter pea and oat mixes.

Table 1. The vegetative truncated runaways (piece/m^2) sowing campaign lucerne

Variant	Under a cover		Uncoatedly	
	The beginning of the vegetative period 2011	The beginning of the vegetative period 2012	The beginning of the vegetative period 2011	The beginning of the vegetative period 2012
$N_0P_0K_0$	700	1,500	840	1,067
$P_{60}K_{90}$-N_{30}*	644	1,033	720	1,022
$P_{90}K_{90}$-N_{30}*	580	1,311	840	1,333
$P_{60}K_{90}$-TE*	520	1,191	632	1,211
$P_{90}K_{90}$-TE*	508	1,233	720	1,400
$P_{60}K_{90}$-BAS*	632	1,011	952	1,333
$P_{90}K_{90}$-BAS*	652	1,289	984	1,439
Least significant difference 05 t ha^{-1}	72	85	84	116

The note. * mineral nitrogen brought only in a year of crops, preseeding processing of seeds by trace elements (TE) or BAS

Influence of doses of fertilizers on formation of runaways in the second and third years of a life of a lucerne depending on ways of sowing are various. It is noticed, that the increase in a dose of phosphoric fertilizers with 60 to 90 kg a. i. ha^{-1} (kg of active ingredient) at uncoated sowing increased quantity of the truncated vegetative runaways by 120 pieces/m^2 on a variant of preseeding entering of starting doses of nitrogen, 88 pieces/m^2 on a variant of preseeding processing of seeds a mix of microcells and did not influence at processing of seeds BAS. At crops under a cover winter pea and oat mixes because of high productivity of its green weight the tendency of decrease in quantity of runaways and only on a variant of preseeding processing of seeds BAS the tendency to their increase (tab. 1, 2) is noted.

In the beginning of the vegetative period of the third year of a life of a lucerne the quantity of the truncated vegetative runaways at uncoated a way of sowing was authentically above on a variant of preseeding processing of seeds a mix of microcells against $P_{90}K_{90}$ (on 167 pieces/m^2) and preseeding processing of seeds BAS against $P_{60}K_{90}$ (on 322 pieces/m^2) and $P_{90}K_{90}$ (on 150 pieces/m^2). On other variants of distinctions in number of the truncated vegetative runaways it is not revealed. Thus, at crops under a cover at sufficient level of a mineral food within the second year of a life of a plant of a lucerne are capable to generate well developed run even at smaller norm of seeding of seeds in comparison with uncoated sowing with double norm of seeding.

Table 2. Productivity of green weight of lucerne herbage depending on biotechnological methods

Variant	Productivity of green weight, dt ha^{-1}				
	2010 r.		2011 r.**	2012 r.	average productivity a lucerne herbage
	winter pea and oat	lucerne			
under a cover winter pea and oat mixes					
$N_0P_0K_0$	294.7	163.6	464.3	766.7	464.9
$P_{60}K_{90}$-N_{30}*	296.0	240.9	434.8	872.0	515.9
$P_{90}K_{90}$-N_{30}*	336.0	178.8	515.8	821.3	505.3
$P_{60}K_{90}$-TE*	237.0	189.8	427.2	873.6	496.9
$P_{90}K_{90}$-TE*	299.0	275.0	460.3	855.2	530.2
$P_{60}K_{90}$-BAS*	297.0	234.1	450.9	942.9	542.6
$P_{90}K_{90}$-BAS*	293.0	195.5	498.3	828.9	507.5
HCP_{05}	25.3	18.2	40.1	73.5	42.2
uncoated sowing					
$N_0P_0K_0$	-	495.0**	430.1	786.7	570.6
$P_{60}K_{90}$-N_{30}*	-	560.0**	476.5	928.0	654.8
$P_{90}K_{90}$-N_{30}*	-	532.8**	556.8	855.9	648.5
$P_{60}K_{90}$-TE*	-	517.9**	426.2	999.2	647.8
$P_{90}K_{90}$-TE*	-	582.8**	539.4	986.7	702.9
$P_{60}K_{90}$-BAS*	-	600.4**	561.9	872.3	678.2
$P_{90}K_{90}$-BAS*	-	493.9**	506.1	1058.5	686.2
HCP_{05}		46.7	43.1	80.0	58.9

Notes: * mineral nitrogen brought only in a year of crops, preseeding processing of seeds by trace elements (TE) or BAS; ** total productivity for 2 cutting

Formation of plants on years of a life of a lucerne defines productivity, quality of a herbage (a share of a bean component in it) and according to its efficiency. It is established, that at integumentary crops productivity of green weight of a herbage more low in comparison with uncoated sowing on 106-179 dt ha^{-1} (tab. 2). In the first year at uncoated sowing the lucerne has generated 2 hay crops with productivity of green weight 494-600 dt ha^{-1} depending on applied biotechnological methods. At crops under a cover winter pea and oat mixes – one

hay crop in the beginning of September (164-275 dt ha^{-1}). The winter pea and oat mix has generated 237-336 dt ha^{-1} of green weight.

In the first year of a life of grasses the herbage consisted on 25-50 % of a bean component at crops under a cover and on 41-50 % at uncoated sowing depending on ways of processing of seeds and applied doses of fertilizers. The weed vegetation has been presented to the life first year of annual plants: *Amaranthus spp., Galinsoga parviflora L., Chenopodium album L., Sinapis arvensis L., Matricaria spp., Echinocloa crussgalli L.*) and biennials – *Melandrium album Garcke*. The next years the lucerne share considerably increased and reached more than 70 % depending on applied biotechnological methods (tab. 3).

It is noticed, that in the first hay crop the share of weed vegetation was in 1.5-2 times above, than in the second and the third. It is feature of the antropogenically transformed peat soils in which in the spring in soil the superfluous quantity of mineral nitrogen is formed and at the sufficient maintenance of mobile forms of phosphorus and potassium, weeds well develop till the regrowth moment a lucerne herbage. For 2 and 3 years of a life of a lucerne the weed vegetation is presented basically by cereal grasses: *Poa praténsis*, *Echinocloa crussgalli L.*, *Elytrígia répens*). The botanical structure of weeds did not depend on a way of sowing.

Lucerne crops under a cover winter pea and oat have rendered to a mix beneficial effect (for the account phytocoenotic effect) on botanical structure of a herbage only on a variant without fertilizers. The share of a bean component on this variant on the average was above on 11 % and 3 % in comparison with a variant uncoated sowing (tab. 3). The variation on hay crops and years of researches was within 3-13 %. On variants of entering of mineral fertilizers the opposite tendency is noted. Improvement of a mineral food stimulated lucerne growth. So at uncoated sowing the share of a bean component in a herbage has on the average increased by 8 % in the second year of a life of grasses and on 7 % in the third.

Table 3. Influence biotechnological methods on botanical structure of a lucerne herbage

Variants		Botanical structure, %					
		2011		2012			average for 2 years
		I cutting	II cutting	I cutting	II cutting	III cutting	
		under a cover					
$N_0P_0K_0$	lucerne	56	91	61	85	90	76
	weeds	44	9	39	15	10	24
$P_{60}K_{90}$-N_{30}*	lucerne	52	79	58	87	82	71
	weeds	48	21	42	13	18	29
$P_{90}K_{90}$-N_{30}*	lucerne	61	87	67	81	71	74
	weeds	39	13	33	19	29	26
$P_{60}K_{90}$-TE*	lucerne	31	91	64	78	66	65
	weeds	69	9	36	22	34	35
$P_{90}K_{90}$-TE*	lucerne	40	76	76	87	68	68
	weeds	60	24	24	13	32	32
$P_{60}K_{90}$-BAS*	lucerne	52	92	60	78	74	71
	weeds	48	8	40	22	26	29
$P_{90}K_{90}$-BAS*	lucerne	49	97	71	87	91	78
	weeds	51	3	29	13	9	22
		uncoated sowing					
$N_0P_0K_0$	lucerne	44	80	68	82	77	69
	weeds	56	20	32	18	23	31
$P_{60}K_{90}$-N_{30}*	lucerne	53	93	55	79	100	75
	weeds	47	7	45	21	0	25
$P_{90}K_{90}$-N_{30}*	lucerne	57	88	62	88	86	76
	weeds	43	12	38	12	14	24
$P_{60}K_{90}$-TE*	lucerne	38	90	60	81	75	68
	weeds	62	10	40	19	25	32
$P_{90}K_{90}$-TE*	lucerne	71	92	84	92	77	83
	weeds	29	8	16	8	23	17
$P_{60}K_{90}$-BAS*	lucerne	59	95	85	74	83	79
	weeds	41	5	15	26	17	21
$P_{90}K_{90}$-BAS*	lucerne	70	96	80	91	98	86
	weeds	30	4	20	9	2	14

Notes: * mineral nitrogen brought only in a year of crops, preseeding processing of seeds by trace elements (TE) or BAS

The most effective receptions improving quality of a herbage were – preseeding processing of seeds by a mix of microcells against $P_{90}K_{90}$ and BAS on $P_{60}K_{90}$ and $P_{90}K_{90}$. On variant $P_{90}K_{90}$-TE in the second year of a life of grasses the lucerne share in a herbage was up to standard of 71 % in I hay crop and 92 % in II hay crop, for the third year of a life – 84, 92 and 77 % in I, II and III hay crops accordingly. On variant $P_{60}K_{90}$-BAS the lucerne share was 59 % in I hay crop and 95 % in II hay crop, for the third year of a life – 85, 74 and 83 % in I, II and III hay crops accordingly. On variant $P_{90}K_{90}$-BAS: in the second year of a life – 70 % and 96 % in I and in II hay crops, for the third year of a life – 80, 91 and 98 % in I, II and III hay crops

according to (tab. 3).

Quality of herbage in general defines its efficiency. It is established that the share of a bean component in herbage is higher, the exit of fodder units and protein content is more. The estimation of level of productivity and quality of a herbage has shown, that the most effective reception of cultivation of a lucerne is uncoated sowing. Efficiency a lucerne herbage in this variant in 1.17-1.43 times (depending on biotechnological methods) above in comparison with crops under a cover winter pea and oat mixes (tab. 4). As on variants with preseeding processing of seeds by a mix of microcells against $P_{90}K_{90}$ and BAS on $P_{60}K_{90}$ and $P_{90}K_{90}$ the share of a bean component was on the average 79-86 % also efficiency on these variants was up to standard 80.7-87.9 dt f. u. (feed units) ha^{-1}.

Table 4. Average for 3 years agroeconomic efficiency of lucerne sowing campaign cultivation and manufacture from it haylage

Variants	Productivity, dt f.u. ha^{-1}		Exchangeable energy, GJ ha^{-1}		Digested protein, dt ha^{-1}		Conditional profit, \$ ha^{-1}
	cover culture**	lucerne	cover culture**	lucerne	cover culture**	lucerne	
under a cover winter pea and oat mixes							
$P_{60}K_{90}$-N_{30}*	37.7	58.9	33.55	68.30	5.0	6.2	125.8
$P_{90}K_{90}$-N_{30}*	38.1	60.8	33.89	70.53	5.1	6.5	97.3
$P_{60}K_{90}$-TE*	30.2	56.8	26.86	65.75	4.0	6.0	100.2
$P_{90}K_{90}$-TE*	42.8	60.8	38.08	70.45	5.7	6.4	111.0
$P_{60}K_{90}$-BAS*	37.9	64.8	33.66	75.16	5.0	6.9	172.8
$P_{90}K_{90}$-BAS*	37.4	63.7	33.21	74.08	5.0	6.8	129.9
uncoated sowing							
$P_{60}K_{90}$-N_{30}*	-	72.7	-	84.13	-	7.6	129.0
$P_{90}K_{90}$-N_{30}*	-	77.7	-	90.15	-	8.3	121.0
$P_{60}K_{90}$-TE*	-	70.8	-	81.89	-	7.4	111.4
$P_{90}K_{90}$-TE*	-	86.9	-	101.06	-	9.3	175.3
$P_{60}K_{90}$-BAS*	-	80.7	-	93.64	-	8.6	186.5
$P_{90}K_{90}$-BAS*	-	87.9	-	102.42	-	9.5	185.3

Notes: * mineral nitrogen brought only in a year of crops, preseeding processing of seeds by trace elements (TE) or BAS; ** efficiency, exchange energy and digested protein of integumentary culture only in a year of crops, 2010

These variants can be noted and at lucerne crops under a cover. Efficiency level on them was 60.8; 64.8 and 63.7 dt f. u. ha^{-1} accordingly at preseeding processing of seeds by mix TE against $P_{90}K_{90}$ and BAS on $P_{60}K_{90}$ and $P_{90}K_{90}$. The analysis of data on efficiency shows, that at lucerne crops under a cover influence various biotechnological methods (processing of seeds, entering of various doses of fertilizers) is levelled, and average efficiency of a lucerne for 3 years of a life of grasses makes 57.5-64.8 dt f. u. ha^{-1}. Authentic increases are received only on effective variants in comparison with the control. At lucerne crops in the pure state uncoatedly efficiency of the most effective variants on 13.4-20.6 dt f. u. ha^{-1} above in comparison with the control and on 9.2-10.3 dt f. u. ha^{-1}, than on variants of entering N_{30} against $P_{60}K_{90}$ and $P_{90}K_{90}$ or preseeding processing of seeds TE against $P_{60}K_{90}$. Reception of preseeding processing of seeds BAS against entering $P_{60}K_{90}$ allows to receive efficiency (80.7 dt f. u. ha^{-1}) similar as on a variant of preseeding entering of starting doses of nitrogen against $P_{90}K_{90}$ (77.7 dt f. u. ha^{-1}).

In the first year of a life of a lucerne at the expense of efficiency winter pea and oat mixes total efficiency surpasses it on 2.0-15.1 dt f. u. ha^{-1} in comparison with uncoated sowing and makes 49.8-64.1 dt f. u. ha^{-1} depending on biotechnological methods. It defines also average efficiency for years of researches. However on the second and the third, probably, and the next years lives efficiency a lucerne herbage on 1.7-27.8 and 6.2-35.9 dt f. u. ha^{-1} above in comparison with crops of grasses under a cover.

The defining factor in a choice of a way of sowing, processing of seeds and doses of fertilizers is economic efficiency of cultivation of a lucerne and manufacture from it haylage, and also gathering digested protein and exchange energy. It is established, that on the basic agroeconomic parametres at uncoated sowing better forages are received: the exit digested protein and exchange energy from a lucerne herbage was on 1.4-2.9 dt ha^{-1} and 15.83-30.61 GJ ha^{-1} above in comparison with crops under a cover (tab. 4).

At crops under a cover variants of processing of seeds BAS against entering $P_{60}K_{90}$ and $P_{90}K_{90}$ are noted. At uncoated sowing by the most effective on nutritiousness variants of processing of seeds microcells and BAS against entering $P_{90}K_{90}$ are. Reception of processing of seeds BAS against $P_{60}K_{90}$ allows to receive forages on nutritiousness same, as on a variant of preseeding entering of

starting doses of nitrogen against $P_{90}K_{90}$ (tab. 4).

Uncoated lucerne sowing on the antropogenically transformed peat soils is also more economic reception, despite the raised norm of seeding. The conditional profit was 3.2-64.3 $ ha^{-1} higher in comparison with crops under a cover and depending on ways of processing of seeds and doses of fertilizers. The highest conditional profit 172.8 and 129.9 $ ha^{-1} is received on variants of processing of seeds BAS against entering $P_{60}K_{90}$ and $P_{90}K_{90}$ accordingly at crops under a cover. These options were effective and at uncoated sowing, the profit made 186.5 and 185.3 $ ha^{-1} that for 11.2 and 10 $ ha^{-1} is higher in comparison with option of processing of seeds microcells against $P_{90}K_{90}$ (tab. 4).

CONCLUSIONS

On the antropogenically transformed peat soils of Polesye it is possible to cultivate effectively a lucerne a sowing campaign and to receive 56.8-87.9 dt f. u. ha^{-1} of high-quality forages depending on application biotechnological methods.

At lucerne cultivation on these soils uncoated sowing with the doubled norm of seeding is more effective in comparison with crops under winter pea and oat a mix. At uncoated sowing of a lucerne an exit of fodder units from hectare above on 13.8-26.1; digestible a protein – on 1.4-2.9 dt ha^{-1}and exchange energy – on 15.8-30.6 GJ ha^{-1} in comparison with crops under a cover.

The application of various biotechnological methods has effectively affected only the uncoated sowing.

4. The assessment of agroeconomic efficiency of lucerne cultivation showed that perspective option is processing of seeds BAS against introduction of against entering $P_{60}K_{90}$ and $P_{90}K_{90}$. This reception provides efficiency 80.7 both 87.9 dt f. u. ha^{-1} and conditional profit 186.5 and 185.3 $ ha^{-1} accordingly. Processing of seeds BAS against entering $P_{60}K_{90}$ by efficiency (an exit of fodder units, digested protein and exchangeable energy) is comparable to a variant of entering of starting doses of nitrogen against $P_{90}K_{90}$, however conditional profit on this variant on 65.5 $ per ha above.

REFERENCES

[1]Епифанов, В.С., Епифанова, И.В., 2004, Влияние норм высева семян на урожайность многолетних бобовых трав, Кормопроизводство, № 5:26-28

[2]Лихацевич, А.П., Авраменко, Н.М., Ткач В.В., 2011, Изменение свойств маломощной торфяной почвы в процессе многолетнего сельскохозяйственного использования, Весці Нацыянальнай акадэміі навук Беларусі, Сер. Аграрн. Навук, № 2:60-65

[3]Лученок, Л.Н., 2008, Перспектива возделывания люцерны посевной на торфяно-песчаных почвенных комплексах Белорусского Полесья, Земляробства і ахова раслін, №4(59):12-15

[4]Лученок, Л.Н., Червань, С.Г., Пташец, О.В., 2011, Сравнительная агроэкономическая эффективность возделывания бобовых трав на антропогенно-преобразованных торфяных почвах Белорусского, Земляробства і ахова раслін, №2(75):11-15

[5]Новиков, С.С., 2002, Мнимые и условные прибыли: отражение в учете и налогообложении, Аудитор, №4:17-19

[6]Русак, Т.И., Шкутов, Э.Н., 2008, Влажность устойчивого завядания на старопахотных торфяных почвах Полесья, Мелиорация, № 2(60):154-162

[7]Семененко, Н.Н., Каранкевич, Е.В., 2011, Трансформация химического состава торфяных почв под влиянием осушения и длительного сельскохозяйственного использования, Весці Нацыянальнай акадэміі навук Беларусі, Сер. Аграрн. Навук, № 1:45-50