The influence of grassing and harvest management on microbial parameters after arable land setting-aside

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ABSTRACT

During the years 1998–2000 soil chemical (C_{org}, N_t, pH), textural (sand, silt clay) and microbiological (microbial biomass carbon – C_{MB}, microbial extracellular carbon – C_{EX}, respiration, ammonification, nitrification) characteristics were tested on grassed chernozem [mollisol] after arable land setting-aside. Different harvest management was also tested: black and green fallow, one or two mulching per year, three cuts with plant biomass removal. For the evaluation of the influence of management and plants we have used three main criteria: (1) µg C_{MB}/g dry soil, (2) ratio C_{MB}/C_{org} (%), (3) µg C_{EX}/mg C_{MB} or eight criteria respectively: (4) ratio of measured and model values of C_{MB}, (5) ratio of measured and model values of C_{EX}/C_{MB}, (6) potential respiration with glucose, (7) potential ammonification with peptone and (8) potential nitrification with $(NH_4)_2SO_4$. According to these criteria, the best harvest management after arable land setting-aside from 5 different systems, which were tested, could be based on one or two mulching per year. It could be stressed that the two mulching was evaluated as the best in sum of dry mass yield (27.5 for mixtures, 20.1 for legumes and 14.2 for grasses – in t/ha/3 years). The use of legumes (*Trifolium repens* L. – *Medicago lupulina* L. – *Lotus corniculatus* L. – *Medicago media* Pers.) or grasses [*Bromus catharticus* Vahl – *Arrhenatherum elatius* (L.) Presl – *Festuca pratensis* Huds – *Dactylis aschersoniana* Graebn.] as cover plants was more successful than the use of their mixtures.

Keywords: arable land setting-aside; grassed chernozem [mollisol]; *Bromus catharticus* Vahl; *Arrhenatherum elatius* (L.) Presl; *Festuca pratensis* Huds; *Dactylis aschersoniana* Graebn.; fallow; legumes; *Trifolium repens* L.; *Medicago lupulina* L.; *Lotus corniculatus* L.; *Medicago media* Pers.; microbial biomass carbon; extracellular microbial carbon; soil biological activity; respiration; ammonification; nitrification; criteria for top-soil ranking

Microorganisms play an important role in the functioning of any soil ecosystem; they are involved in the litter breakdown, cycling of nutrients, formation of stable microagregates, and structural development (Alexander 1977).

Different soil management (manuring, crop rotation, soil cultivation, etc.) influences not only physical and chemical properties of soil but especially it can very strongly change biological properties of soil (Voříšek 2001). These phenomena were confirmed for undisturbed soils (Růžek 1995) and for reclaimed soils (Růžek 1994, Růžek et al. 2001).

Soil biological activity (Nannipieri et al. 1990) or soil quality (Elliott et al. 1996) are the mostly used terms for describing the importance of soil biota (esp. microorganisms) for soil processes. These authors stressed the idea that soil quality is a dynamic feature, and any significant indicators must be sensitive to small changes in key soil properties.

It is widely known that the evaluation of the soil biological activity should be done with several methods (Nannipieri et al. 1990, Schinner et al. 1995, Paul and Clark 1996 etc.). Usually the spectrum of recommended methods is focused on analyses of the carbon, nitrogen, sulphur and phosphorus cycles, on determination of microorganisms counts and microbial biomass. The study of metabolic processes of living microorganisms and soil enzyme activities could be also useful (Schinner et al. 1995). These biological tests have to be completed with several chemical and physical characteristics.

The objectives of our studies were to examine soil physical, chemical, and microbial characteristics after abandonment of regular cultivation on grassed soils.

MATERIAL AND METHODS

Experiments were carried out at the University Field Experimental Station in Prague-Suchdol (latitude 50°07'40'' N, longitude 14°22'40'' E, elevation 287 m, average rainfall 510 mm, chernozem [mollisol]).

Experimental field, formerly used in arable system with usual crop rotation (change in 1996), was divided into experimental plots (10 m × 3 m), some of them are used as a fallow, others were sown with grasses: [*Bromus catharticus* Vahl – *Arrhenatherum elatius* (L.) Presl – *Festuca pratensis* Huds – *Dactylis aschersoniana* Graebn.] or with legumes: (*Trifolium repens* L. – *Medicago lupulina* L. – *Lotus corniculatus* L. – *Medicago media* Pers.) or with mixtures (legumes and grasses). In addition, different harvest management was introduced: 3 cuts/year with plant biomass removal, 1 mulching/year, 2 mulching/year.

From these variants the following were sampled and tested (some details see Table 1):
a) black fallow
b) green fallow

c) 1 mulching/year – grass
d) 1 mulching/year – legumes
e) 1 mulching/year – mixture (grass + legumes)
f) 2 mulching/year – grass
g) 2 mulching/year – legumes
h) 2 mulching/year – mixture (grass + legumes
i) 3 cuts with plant biomass removal/year – grass
j) 3 cuts with plant biomass removal/year – legumes
k) 3 cuts with plant biomass removal/year – mixture (grass + legumes)

Soil samples were taken from top-soil (0–200 mm) 2–3 times during the years 1998–2000 with soil sampler (Eijkelkamp Agrisearch Equipment). Each soil sample was a mixture of 8 sampling sites. Soil samples were immediately transported to the laboratory, they were homogenized and sieved (mesh 2 mm), and stored in refrigerator at 4°C before analyses.

A set of 15 tests was used for soil sample characterization (and additionally several ratios were calculated): organic carbon (C_{org}, Sims and Haby 1971), total nitrogen content (N_t), pH (H_2O), pH (KCl), sand – silt – clay (ISO 11277 – details see Table 1), microbial biomass carbon (C_{MB}, Blagodatskiy et al. 1987), microbial extracellular carbon (C_{EX}, Badalucco et al. 1992), potential respiration with glucose (Novák and Apfelthaler 1964), potential ammonification with peptone (Pokorná-Kozová et al. 1964), potential nitrification with ammonium sulphate (Löbl and Novák 1964).

RESULTS AND DISCUSSION

The chemical and textural soil parameters of experimental plots (Table 1) are mostly typical for chernozem [mollisol]. Seven tested plots are characterised by usual content of organic C (1.33–1.50%), 4 plots have lower level (1.11–1.27%). It is not surprising that black fallow with the lowest input of organic substances belongs to the group with low level of organic C (1.25%).

Deficiency of available carbon resulted (Table 2a) in the highest mineralisation activity after amendment of glucose to the soil sample that could be documented with the highest ratio (13.17) between potential respiration and control respiration. The rest of plots were characterised by values 6.83–10.83. Content of nitrates was again the highest in black fallow, in contrast in green fallow the nitrate content was the lowest. The data from potential respiration and potential ammonification indicate that soil microbial communities were not destroyed, they remain quite active.

Similar results were received by Boehm and Anderson (1997) which have stated that the continuous cropping system gives better results in organic C soil content, aggregate size and its stability, microbial biomass, potential nitrification in comparison with the plots where fallow was introduced every second or every 3rd–5th year.

Determination of microbial biomass carbon (C_{MB}) belongs to common test for evaluation of soil microbial status. Our experimental plots were characterised in the range 325.64–457.95 µg C_{MB}/1 g dry soil (Table 2b). According to the former experience (586 soil samples analyses) the average C_{MB} level for Czech arable and grassed soils is 453.64 (*SD* 129.09) µg C_{MB}/1 g dry soil, for chernozem [mollisol] average is lower – 418.22 µg C_{MB}/1 g dry soil (Růžek 1999). The total C_{MB} average in described experiment was 377.16 (*SD* 69.77) µg C_{MB}/1 g dry soil. Only three values from our experimental plots are closer to the average mentioned above (in µg C_{MB}/1 g dry soil): 411.99 – grass – 2 mulching/year; 433.65 – legumes 1 mulching/year; 457.95 – legumes – 2 mulching/year. The lowest C_{MB}

Table 1. Chemical and textural characteristics of soils

Management	Plants	C_{org} (%)	N_t (%)	C_{org}/N_t ratio	pH (H_2O)	pH (KCl)	Sand[4] (0.063–2 mm)	Silt[4] (0.002–0.062 mm)	Clay[4] < 0.002 mm	Soil moisture content[5] (g)
Black fallow		1.25	0.13	9.59	7.62	6.99	26.50	44.00	29.50	15.73
Green fallow		1.48	0.15	9.84	7.40	6.79	25.40	47.10	27.50	16.83
1 mulching/y	grass[1]	1.40	0.15	9.35	7.52	6.85	22.60	47.70	29.70	17.03
	legumes[2]	1.50	0.18	8.33	7.67	7.02	20.90	50.10	29.00	16.34
	mixtures[3]	1.43	0.16	8.96	7.72	7.04	17.00	54.70	28.30	15.72
2 mulching/y	grass[1]	1.42	0.17	8.33	7.59	6.96	23.60	48.30	28.10	17.22
	legumes[2]	1.39	0.17	8.16	7.72	7.10	21.60	50.70	27.70	16.83
	mixtures[3]	1.33	0.14	9.47	7.82	7.07	20.70	52.60	26.70	15.35
3 cuts/y with removal	grass[1]	1.27	0.15	8.43	7.74	7.03	23.80	47.40	28.80	15.46
	legumes[2]	1.11	0.14	7.95	7.74	7.11	20.40	52.20	27.40	14.42
	mixtures[3]	1.14	0.11	10.39	7.80	7.11	22.10	49.80	28.10	15.00

[1] *Bromus catharticus* Vahl – *Arrhenatherum elatius* (L.) Presl – *Festuca pratensis* Huds – *Dactylis aschersoniana* Graebn.
[2] *Trifolium repens* L. – *Medicago lupulina* L. – *Lotus corniculatus* L. – *Medicago media* Pers.
[3] *Festuca pratensis* Huds and *Lotus corniculatus* L., *Trifolium repens* L. and *Dactylis aschersoniana* Graebn.
[4] ISO 11277
[5] gravimetric lost after drying at 105°C for 24 h/100 g

Table 2a. Microbial characteristics of soils

Management	Plants	Respiration[4]			Ammonification[5]			Nitrification[6]		
		control	potential	ratio	control	potential	ratio	control	potential	ratio
Black fallow		0.23	2.81	13.17	17.67	189.20	11.38	2.31	19.65	13.52
Green fallow		0.33	2.67	8.41	20.44	175.44	9.41	1.11	20.85	29.02
1 mulching/year	grass[1]	0.36	2.87	8.09	21.51	202.40	10.13	1.32	27.40	42.83!
	legumes[2]	0.43	3.48	8.99	21.38	187.63	9.75	2.29	36.18!	19.13
	mixtures[3]	0.35	3.55	10.69	19.91	185.87	9.87	1.96	32.39!	22.47
2 mulching/year	grass[1]	0.41	2.68	6.83	20.54	183.35	9.79	1.13	20.97	37.64!
	legumes[2]	0.33	3.26	10.83	20.85	166.61	8.76	2.20	26.05	15.17
	mixtures[3]	0.32	2.81	9.00	17.53	181.14	10.72	2.01	27.42	18.49
3 cuts/year with removal	grass[1]	0.32	2.37	7.55	18.38	178.79	10.41	1.22	19.58	28.73
	legumes[2]	0.29	2.64	9.41	17.97	158.58	9.48	1.73	24.05	21.37
	mixtures[3]	0.29	2.48	9.10	17.84	158.76	9.41	1.45	23.48	21.22
Significance level (*F*-test)		0.0012	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
LSD[7] $d_{\alpha \min}$ 0.05 (0.01)		0.08 (0.11)	0.98 (1.30)	4.25 (5.64)	4.52 (6.00)	42.89 (56.99)	4.53 (6.02)	1.48 (1.97)	14.87 (19.75)	20.39 (27.08)

[1, 2, 3] see Table 1, [4] mg CO_2/h/100 g dry soil, [5] mg N-NH_4^+/24 h/100 g dry soil, [6] mg N-NO_3^-/8 days/100 g dry soil,
[7] Fischer's Least Significant Difference
! extreme value

content (325.64 µg C_{MB}/1 g dry soil, *SD* 50.54) was at black fallow. For the plots with legumes in each management group the highest content of C_{MB} is typical. The highest input of plant biomass through 2 mulching/year resulted in the highest level of C_{MB} (in µg C_{MB}/1 g dry soil): 415.04 – 2 mulching/year, 387.01 – 1 mulching/year, 360.78 – 3 cuts with plant biomass removal/year, 342.73 – green fallow, 325.64 – black fallow.

Robertson et al. (1993) have determined 420 µg C_{MB}/1 g pasture soils and only 214 µg C_{MB}/1 g in cultivated soil. Pasture soils respired more CO_2 than cultivated soil. According to their opinion, this was due to an increase in the amount rather than in the specific activity of the microbial biomass.

Table 2b shows the data about extracellular microbial carbon (C_{EX}), which is preferred by microbial soil communities as an important source of carbon and energy. Higher C_{EX} level is a sign for lower metabolic activity of microorganisms. Value µg C_{EX}/mg C_{MB} is very important for the describing of metabolic activity in utilising of microbial extracellular organic compounds. We have found significant differences ($p < 0.01$) between plots with grasses (72.37 µg C_{EX}/mg C_{MB}, *SD* 12.41) and plots with mixtures (113.15 µg C_{EX}/mg C_{MB}, *SD* 23.96).

Table 2b. Microbial characteristics of soils

Management	Plants	C_{MB}[4] (µg/g dry soil)	C_{EX}[5] (µg/mg C_{MB})	C_{MB}/C_{org} (%)
Black fallow		325.64	72.68	2.62
Green fallow		342.73	95.88	2.33
1 mulching/year	grass[1]	370.15	75.09	2.65
	legumes[2]	433.65	93.38	2.90
	mixtures[3]	357.23	129.13!	2.50
2 mulching/year	grass[1]	411.99	73.54	2.91
	legumes[2]	457.95	94.52	3.33
	mixtures[3]	375.17	99.60	2.84
3 cuts/year with removal	grass[1]	366.89	68.47	2.91
	legumes[2]	380.36	78.10	3.43
	mixtures[3]	335.08	110.71	2.95
Significance level (*F*-test)		0.0032	0.0001	0.0053
LSD[6] $d_{\alpha \min}$ 0.05 (0.01)		66.02 (87.72)	25.03 (33.26)	0.55 (0.73)

[1, 2, 3] see Table 1, [4] C_{MB} – microbial biomass carbon, [5] C_{EX} – microbial extracellular carbon extractable by 0.5 mol/l K_2SO_4,
[6] Fischer's Least Significant Difference
! extreme value

Table 3a. Results of evaluation based on three biological criteria[1]

Management	Plants	Ranking based on three biological criteria[1]	Dry mass yield (t/ha) 1998 + 1999 + 2000	Grass – Legumes – Weeds (%) 1998 + 1999 + 2000
2 mulching/year	legumes	1	20.051	34 – 42 – 24
3 cuts/year with removing	legumes	2	19.711	12 – 71 – 17
2 mulching/year	grass	3	14.175	72 – 8 – 20
3 cuts/year with removing	grass	4	8.185	80 – 2 – 18
1 mulching/year	legumes	5	9.716	49 – 34 – 17
1 mulching/year	grass	6	10.647	79 – 2 – 19
2 mulching/year	mixtures	7	27.517	55 – 38 – 7
Black fallow		8	–	–
3 cuts/year with removing	mixtures	9	23.338	47 – 45 – 8
Green fallow		10	11.213	39 – 3 – 58
1 mulching/year	mixtures	11	14.507	67 – 29 – 4

[1] three biological criteria: 1. µg C_{MB}/g dry soil, 2. ratio C_{MB}/C_{org} (%), 3. µg C_{EX}/mg C_{MB}
C_{MB} – microbial biomass carbon, C_{EX} – extracellular microbial carbon extractable by 0.5 mol/l K_2SO_4, C_{TT} – extractable part of C_{MB} + C_{EX}

Microbial biomass is the most active part of soil organic matter and ratio C_{MB}/C_{org} was stressed (Insam and Domsch 1988) as the very important indicator of soil microbial status. According to our former experience (Růžek 1999), the range of this ratio is 2.5–4.5% at arable and grassed soils, for chernozem [mollisol] the average is 2.97%. The values (2.33–3.43%) from described experiment are typical for chernozem [mollisol]. The lowest value was determined for green and black fallow (average 2.48%); there was a statistical difference ($p < 0.01$) with plots with legumes (average 3.24%).

Biological activities of experimental soils were determined by respiration, ammonification and nitrification. In the Table 2a, several differences could be seen but the only statistical significant difference ($p < 0.05$) was in control respiration of mulching plots (in mg CO_2/100 g dry soil/h: 1 mulching 0.38, 2 mulching 0.35) in comparison with black fallow (0.23 mg CO_2/100 g dry soil/h).

For the general evaluation of the influence of plants and harvest management on soil biological characteristics three criteria were used (Table 3a):
1. µg C_{MB}/g dry soil
2. ratio C_{MB}/C_{org} (%)
3. µg C_{EX}/mg C_{MB}

or eight criteria were used (Table 3b):
1. µg C_{MB}/g dry soil – measured values
2. ratio of measured and model predicted C_{MB} values (Table 4a, b)
3. ratio C_{MB}/C_{org} (%)
4. µg C_{EX}/mg C_{MB} – measured values
5. ratio of measured and model predicted C_{EX}/C_{MB} values (Table 4a, b)
6. potential respiration with glucose
7. potential ammonification with peptone
8. potential nitrification with $(NH_4)_2SO_4$

Table 3b. Results of evaluation based on eight biological criteria[1]

Management	Plants	Ranking based on eight biological criteria[1]	Dry mass yield (t/ha) 1998 + 1999 + 2000	Grass – Legumes – Weeds (%) 1998 + 1999 + 2000
1 mulching/year	legumes	1	9.716	49 – 34 – 17
1 mulching/year	grass	2	10.647	79 – 2 – 19
2 mulching/year	legumes	3	20.051	34 – 42 – 24
2 mulching/year	grass	4	14.175	72 – 8 – 20
3 cuts/year with removal	legumes	5	19.711	12 – 71 – 17
2 mulching/year	mixtures	6	27.517	55 – 38 – 7
Black fallow		7	–	–
1 mulching/year	mixtures	8	14.507	67 – 29 – 4
3 cuts/year with removal	grass	9	8.185	80 – 2 – 18
Green fallow		10	11.213	39 – 3 – 58
3 cuts/year with removal	mixtures	11	23.338	47 – 45 – 8

[1] eight biological criteria: 1. µg C_{MB}/g dry soil – measured values (C_{MB} – microbial biomass carbon), 2. µg C_{MB}/g dry soil – model predicted values (Table 4a, b), 3. ratio C_{MB}/C_{org} (%), 4. µg C_{EX}/mg $C_{MB.}$ – measured values (C_{EX} – extracellular microbial carbon extractable by 0.5 mol/l K_2SO_4), 5. µg C_{EX}/mg $C_{MB.}$ – model predicted values (Table 4a, b), 6. potential respiration with glucose, 7. potential ammonification with peptone, 8. potential nitrification with $(NH_4)_2SO_4$

Table 4a. Model[e] (2001) used for evaluation of measured criteria

Model $C_{EX} = W + (V \times 0.0001\ C_{org}{}^{a}) + A - B$		
Model $C_{TT} = Y + [(X \times 0.0001\ C_{org}{}^{a}) \times (C + D + E + F)]$		
Model C_{MB} = (Model C_{TT} – Model C_{EX})/0.25[b]		
Coefficients[d] defining relation between C_{org}, C_{EX} and C_{TT}		
$V = 40.090$	$0.9038\ V + W = 24.4007$	
$W = -11.833$	$1.7780\ V + W = 59.4473$	
$X = 91.491$	$0.9038\ X + Y = 109.8071$	
$Y = 27.117$	$1.7780\ X + Y = 189.7889$	
Coefficients derived from correlation with C_{MB}		
$p < 0.05^{*}; 0.01^{**}; 0.0001^{***}$ (n = 2178)		
$A = 0.2466 \times$ sand[f]	Ø 22.85%	$r = -0.1590^{***}$
$B = 0.1545 \times$ silt[g]	Ø 54.98%	$r = 0.2396^{***}$
$C = 0.2777 \times [N_t{}^{c}/(C_{org}{}^{a}/8.75)]$		$r = -0.1464^{***}$
$D = 0.0658/[(Q_{4/6} + 6.39)/12.78]$		$r = -0.0347$
$E = 0.2850/[(\text{pH } H_2O + 6.89)/13.78]$		$r = 0.1502^{***}$
$F = 0.3715/[(\text{pH } H_2O + \text{pH KCl})/(2 \times \text{pH KCl})]$		$r = -0.1958^{***}$

[a] carbon of soil organic matter (µg/g), [b] coefficient (Blagodatskiy et al. 1987), [c] total nitrogen – Kjeldahl (µg/g), [d] computed by substitution method, [e] Růžek (1994, 1995, 1999), Dušek et al. (1997), Růžek et al. (2001), [f] ISO 11277 (0.063–2.00 mm), [g] ISO 11277 (0.002–0.062 mm)

According to these criteria (Table 3a, b), the best harvest management after arable land setting-aside from 5 different tested systems could be based on one or two mulching per year. It could be stressed that the two mulching was evaluated as the best in sum of dry mass yield – 20.6 t/ha/3y (average of three plant variants). In comparison with 3 cuts dry mass yield was 17.1 t/ha/3y and for one mulching only 11.6 t/ha/3y.

Correlation between measured values of C_{MB}, C_{EX} and chemical, textural and biological characteristics is given in Table 5.

The use of legumes (*Trifolium repens* L. – *Medicago lupulina* L. – *Lotus corniculatus* L. – *Medicago media* Pers.) or grasses (*Bromus catharticus* Vahl – *Arrhenatherum elatius* (L.) Presl – *Festuca pratensis* Huds – *Dactylis aschersoniana* Graebn.) as cover plants was more successful than the use of legumes and grasses in mixtures.

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Table 4b. Model predicted values

Management	Plants	C_{MB}[4] Model predicted minimum (µg/g dry soil)	C_{EX}[5] Model predicted maximum (µg/mg C_{MB})
Black fallow		387.38 (84%)[7]	97.72 (74%)[7]
Green fallow		431.87 (79%)[7]	107.23 (89%)[7]
1 mulching/y	grass[1]	427.04 (87%)[7]	99.64 (75%)[7]
	legumes[2]	467.59 (93%)[7]	97.65 (96%)[7]
	mixtures[3]	446.96 (80%)[7]	92.49 (140%)[7]
2 mulching/y	grass[1]	447.87 (92%)[7]	96.61 (76%)[7]
	legumes[2]	447.98 (102%)[7]	92.05 (103%)[7]
	mixtures[3]	409.77 (92%)[7]	93.35 (107%)[7]
3 cuts/y with removing	grass[1]	412.71 (89%)[7]	90.67 (76%)[7]
	legumes[2]	397.91 (96%)[7]	74.68 (105%)[7]
	mixtures[3]	361.94 (93%)[7]	87.61 (126%)[7]
Significance level (F-test)		0.0001	0.0001
LSD[6] $d_{\alpha\ min}$ 0.05 (0.01)		8.33 (11.07)	6.77 (9.00)

[1, 2, 3] see Table 1, [4] C_{MB} – microbial biomass carbon, [5] C_{EX} – microbial extracellular carbon, [6] Fischer's Least Significant Difference, [7] measured value in per cent (model value = 100%)

Table 5. Correlation between measured values of C_{MB}, C_{EX} and chemical, textural and biological characteristics

	C_{MB}[1] (μg/g dry soil)	C_{EX}[2] (μg/mg C_{MB})
Total nitrogen – Kjeldahl (N_t)	0.4412** (.0001)[4]	–0.0380
Ratio C_{org}/N_t	–0.4019** (.0003)[4]	0.1844
pH (H_2O)	0.5731*** (.0000)[4]	–0.0585
pH (KCl)	0.5113*** (.0000)[4]	–0.0176
Sand[5] (0.063–2 mm)	–0.1642	–0.4243** (.0001)[4]
Silt[5] (0.002–0.062 mm)	0.1702	0.4378** (.0001)[4]
Clay[5] < 0.002 mm	–0.0933	–0.2340* (.0419)[4]
Control respiration	0.3719** (.0009)[4]	–0.0497
Potential respiration with glucose	0.3728** (.0009)[4]	0.0774
Content of N-NH_4^+	–0.2382* (.0382)[4]	0.1175
Potential ammonification with peptone	0.4395** (.0001)[4]	–0.2221
Content of N-NO_3^-	0.5921*** (.0000)[4]	–0.1053
Potential nitrification with $(NH_4)_2SO_4$	0.4940*** (.0000)[4]	–0.0445

[1] C_{MB} – microbial biomass carbon, [2] C_{EX} – extracellular microbial carbon extractable by 0.5 mol/l K_2SO_4,
[3] probability of interaction: $p < 0.05^{*;}\ 0.01^{**;}\ 0.0001^{***}$ (n = 76), [4] significance level, [5]ISO 11277

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ABSTRAKT

Vliv zatravnění a způsobu sklizně na mikrobiální parametry půd uložených do klidu

V průběhu let 1998–2000 byly na zatravněné černozemi s rozdílným způsobem sklizně sledovány chemické parametry (C_{org}, N_t, pH), zrnitostní parametry (písek, prach, jíl) a mikrobiologické parametry (uhlík biomasy mikroorganismů – C_{MB}, mimobuněčný mikrobní uhlík – C_{EX}, respirace, amonifikace, nitrifikace). Rozdílný způsob sklizně zahrnoval černý úhor, zelený úhor, mulčování jednou ročně, dvakrát ročně a seč třikrát ročně s odvozem posečené hmoty. Vliv způsobu sklizně a sledovaných kombinací trav a jetelovin byl zhodnocen za pomoci tří kritérií: (1) μg C_{MB}/g suché půdy, (2) poměru C_{MB}/C_{org} (%), (3) μg C_{EX}/mg C_{MB}, popřípadě osmi kritérií: (4) modelové hodnoty μg C_{MB}/g suché půdy, (5) modelové hodnoty μg C_{EX}/mg C_{MB}, (6) potenciální respirace s glukózou, (7) potenciální amonifikace s peptonem a (8) potenciální nitrifikace s $(NH_4)_2SO_4$. Podle uvedených kritérií se z pěti testovaných způsobů sklizně jako nejlepší ukázalo, po uvedení půdy do klidu, mulčování jetelovin: *Trifolium repens* L.; *Medicago lupulina* L.; *Lotus corniculatus* L.; *Medicago media* Pers. a trav: *Bromus catharticus* Vahl; *Arrhenatherum elatius* (L.) Presl; *Festuca pratensis* Huds; *Dactylis aschersoniana* Graebn. 1–2krát ročně. Směsi trav a jetelovin, jakož i úhory a trojnásobná seč s odvozem, zaujaly po zhodnocení třemi i osmi kritérii horší umístění. Při dvojnásobném mulčování byl zjištěn i nejvyšší kumulativní výnos suché nadzemní hmoty za tříleté období: 27,5 t/ha u směsí, 20,1 t/ha u jetelovin a 14,2 t/ha u trav.

Klíčová slova: orné půdy uvedené do klidu; zatravněná černozem; úhory; *Bromus catharticus* Vahl; *Arrhenatherum elatius* (L.) Presl; *Festuca pratensis* Huds; *Dactylis aschersoniana* Graebn.; *Trifolium repens* L.; *Medicago lupulina* L.; *Lotus corniculatus* L.; *Medicago media* Pers.; C-biomasy mikroorganismů; mimobuněčný mikrobní uhlík; biologická aktivita půdy; respirace; amonifikace; nitrifikace; kritéria pro stanovení pořadí

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