ACTA UNIVERSITATIS AGRICULTURAE ET SILVICULTURAE MENDELIANAE BRUNENSIS
SBORNÍK MENDELOVY ZEMĚDĚLSKÉ A LESNICKÉ UNIVERZITY V BRNĚ

Volume LVII 1 Number 2, 2009

# LONG-TERM EVALUATION OF THE ORGANIC MATTER BALANCE AND ITS RELATIONS TO THE ORGANIC C CONTENT IN THE TOPSOILS IN ÚSTÍ NAD ORLICÍ DISTRICT

J. Dostál, D. Cerhanová, L. Hajzlerová, J. Martincová, P. Pospíšilová, E. Pokorný, T. Lošák

**Received: January 19, 2009**

## Abstract

DOSTÁL, J., CERHANOVÁ, D., HAJZLEROVÁ, L., MARTINCOVÁ, J., POSPÍŠILOVÁ, P., POKORNÝ, E., LOŠÁK, T.: *Long – term evalutation of the organic matter balance and its relations to the organic C content in the topsoils in Ústí nad Orlicí district.* Acta univ. agric. et silvic. Mendel. Brun., 2009, LVII, No. 2, pp. 13–24

Organic matter balance in the farms located in Ústí nad Orlicí district has been investigated since 1979. As a result, so called need of organic fertilisation, has been determined and the supply of the organic fertilisers to soils, e.g. farmyard manure, slurries and also straw and green manure has been monitored over the whole time period. About 45% of the arable land area in the district has been monitored.
In addition to the organic matter balance, we determined several soil organic matter characteristics in soil samples (organic C, N and S contents, inert and decomposable C content, hot water soluble C content, hydrophobicity index calculated from the DRIFT spectrometry, available P, K, Ca and Mg contents and pH).
The relationships between the organic matter supply with supplemental sources organic fertilisers and all the selected soil organic matter characteristics were statistically significant. Significant correlations were also found for the relationships between the organic matter need and all the selected soil organic matter characteristics.

soil organic matter, farm fertilisers, organic fertilisers, agricultural systems

The average production of farm manures (farmyard manure and slurries) in the Czech Republic has been estimated to 0.8–0.9 t organic matter (OM) per hectare of arable land annually, in the present time. Due to the drop down of the number of farm animals during the last years, production of farmyard manure and slurries dropped down, as well. The deficit in organic matter balance has been diminished by means of supplemental resources like straw, green manure or beet leaves application. However, there are large differences in different regions, districts or even farms in the number of farm animals and farm manure production per hectare, as shows Tab. I.

Organic matter balance in selected crop rotations in the farms located in Ústí nad Orlicí district has been calculated since 1979. They are described in the publications Dostál (2002); Dostál et al. (2003); Kubát et al. (2004); Dostál et al. (2006). So called need of organic fertilisation and supply of the farm and organic fertilisers to soils, e.g. farmyard manure, slurries and also straw and green manure has been monitored over the whole time period. The whole acreage of the district was monitored in time period 1981 to 1989. In 1991 to 1998 was the extent diminished to 17 farms, i.e. 23 crop rotations, encompassing about 45% of the arable land area in the district.

In the district, there are several climate regions from the T3 – warm, slightly wet at 10.1% of the agricultural land, MT2 – slightly warm, slightly wet at 16.8% of the agricultural land, MT4 – slightly warm, wet at 43.4% of the agricultural land, MCH – slightly cold, wet at 24.1% of the agricultural land and CH – cold and wet at the 5.7% of the agricultural land. The topography of the region is differentiated (about

37.4% is flat, and about 24% of the agricultural land is on slopes higher than 7°). The soil types are differentiated, as well. There are several subtypes of Luvisols and Cambisols up to acid Spodosols. Majority of soils are medium heavy soils (83%), light soils are much less frequent (14%) and the same is true for the heavy soils (3%). According to the production classification, 10.5% of the agricultural land belongs to the beet region, 67.2% to cereal region and 22.3% belongs to the fodder crop region.

Ústí nad Orlicí district is characterised with a high level of the agricultural production and a high degree of the soil productivity utilisation. One of the beneficial factors is the maintenance of relatively high density of the farm animals and an effective utilisation of the organic farm fertilisers. According to the Czech Statistical Office Report (2000), the density of farm animals is about 50% higher in comparison with the average in the country (0.60 AU.ha$^{-1}$ arable land) and it reached 0.90 animal units (AU) per ha arable land. The share of the cattle (83%) is also more favourable than the average of the whole country (69%). Total number of crop rotations is 62 with average acreage of 814 ha arable land in the present time. With the increasing cost of the transport and privatisation, the number of crop rotations increases and their acreage decreases.

## MATERIALS AND METHODS

Methodology of the so called "need of organic matter determination" in a crop rotation has been described by Neuberg et al. (1990). A normative of the need of organic matter is estimated according to soil textural classes and mainly according to the crop rotation (proportion of crops in crop rotation). Organic matter production was estimated from the registered application of the farm and organic fertilisers using average values of analyses of farm fertilisers or, partly, from the standard recommended values of the organic matter content in farm fertilisers. In the Ústí nad Orlicí district, organic fertilisation has been monitored since 1979 in individual crop rotations.

Since spring 2002 (18$^{th}$ to 25$^{th}$ March), soil samples of 40 selected localities on arable soils (top soil 0–0.2 m) cropped with winter wheat and winter raps were taken, yearly. The selected localities are situated directly in the area or in the vicinity of the areas that have been investigated for the organic matter balance for a long time. The soil samples were thoroughly mixed, passed through 2 mm sieve and air dried at a room temperature. Air dried soil samples were transferred to the laboratory and following characteristics have been determined: organic C content (wet oxidation) according to Alten et al. (1935), total C, N and S content (Leco CNS 2000 elemental analyse, or Vario Max analyse, since 2005), hot water soluble C content (Schulz, 1997), DRIFT spectra and hydrophobicity index (Capriel et al. 1995; 1997).

The results over the time period 2002–2007 have been evaluated in relation to the organic matter balances by means of calculation of the correlation coefficients and chart curves.

## RESULTS AND DISCUSSION

### Organic matter balance

Generally, there are large failings in handling with the organic fertilisers in this country. For this reason, a "Programme of organic fertilisation" had been elaborated in seventies for the Ústí nad Orlicí district. Since that time, several indicators of organic matter balance, selected in frame of this programme, have been monitored up to now. Long-term monitoring of the organic matter balances reflects quite well the consequences of transformation in agriculture during the last decade.

During eighties, the results obtained were relatively positive. Average balance between production and need of organic matter was positive, ranging between 0.36 and 0.71 tons organic matter (OM) per 1 ha of arable land annually for the whole district during 1981 to 1987. Analyses of individual crop rotations has shown that the arable land area showing a deficit in organic matter balance dropped down from 27% to 6% only, during that time period. In 1991, however, similarly to previous two years, the density of farm animals, mainly cattle, diminished and some perennial fodder crops were partly substituted with cash crops in crop rotations (Tab. II). In 2002, the proportion of maize grown for the conservation of wet grains increased. Since 2007, the proportion of the sugar beet growing has dropped down.

These changes and also increasing costs of transport adversely affected organic matter balance in Ústí nad Orlicí district (Tab. III). The proportion of crop rotations with negative or only slightly positive organic matter balance increased (Tab. IV).

In 1992 and also 1993, the negative trend of the previous three years was partly compensated. The number of farm animals was stabilised and, simultaneously, perennial fodder crops acreage increased, as well (Tab. II). Perennial fodder crops have shown to be essential, mainly after the lack of fodder due to the dry weather in previous years. As a consequence, organic matter balance in Ústí nad Orlicí district improved.

After 1992, the number of farm animals in the traditional stables diminished by 10%. On the contrary, the number of pigs slurry producing stables increased by 30%. Supplemental resources of organic matter (e.g. straw, green manure, compost, sewage sludge) changed, as well. Compost production dropped down by 70% and was partly substituted with green manure, acreage of which increased 3 times.

A substantial change occurred in 1995. Positive organic matter balance reached 0.95 t OM.ha$^{-1}$ arable land due to the measures in organic matter utilisation (better quality of liquid manures due to improvement of the stable's technology, increased ploughing of straw and green manure, etc.).

In 2005 the application of supplemental resources reached its maximum. Participation of supplemental organic matter resources in the all resources reached 39.5% (in that: straw 31.2%, green manure 7.8%, compost and sewage sludge 0.5%). Since 2005, intercrop-growing is supported by the government, and therefore, green manure is perspective. In 2006, supplemental organic amount dropped down due to precipitation deficit and hot temperature in July. In 2007, share of supplemental resources reached 36,9%.

During 1997–2007, acreage of cash crops increased on account of perennial fodder crops (Tab. II) and reach 66.3% of arable soil area. Average need of organic matter has therefore increased by 40%, as compared 2003 with 1993 (Tab. III). However, part of previous arable land has been changed to pastures and meadows, which is a practice that is supported by the government.

Organic matter production including the supplemental resources (straw, green manure, composts) has been sufficient to cover the need of organic mater in the monitored area and in the average of the whole district, as well. However, this was not true for each crop rotation and for each field – mainly because of the disparity in the animal breeding over the district area and a similar situation with the crop rotations. In 2006, only about 1/2 of crop rotations comprising about 43% of the total arable land area show sufficient active organic matter balance (Tab. IV) due to the low supplemental organic matter share.

Besides of the production of organic fertilisers and their organic matter content, their kinds and doses are important, too (Mengel and Kirkby, 2001). During 2002–2007, 33% of the arable land was fertilised with farm and organic fertilisers in the investigated territory. On an average of 3 years, the applied dose have comprised 21.1 t farmyard manure, 0.9 t poultry manure, 0.27 t compost and sewage sludge, 3.2 t straw, 3.5 t green manure, 13.6 t cattle slurry, 3.7 t pig slurry and 0.03 t others organic fertilisers per 1 ha.

As calculated to 1 ha of the investigated territory, the total organic matter production in farm manures amounted to 1.66 t annually, during 2002–2007. Share of farmyard manure was 1.20 t, poultry manure 0.12 t, cattle slurry 0.26 t and the pig slurry 0.08 t, annually. Supplemental organic resources application included 0.92 t of organic matter in total, 0.85 t in straw, 0.13 t in green manure, and 0.018 t in compost and sewage sludge. The average nutrient input in farm and organic fertilisers was 73.8 kg N, 42.4 kg $P_2O_5$ and 75.5 kg $K_2O$, which is 191.7 kg per ha in total annually. Above results extend previous data from Dostál (2002).

### Relationships between the organic matter balances and the soil organic matter characteristics

The results of the long-term determination of the organic matter need, production and balance in the Ústí nad Orlicí district were related to the results of the analyses of the soil organic matter.

The results of investigations (2002–2007) have been evaluated by means of calculation correlation coefficients between the selected characteristics of the soil organic matter content and quality and the long-term organic matter (OM) balances in the selected localities. Significant correlations were found mainly between the organic matter need and all the selected soil organic matter characteristics. The relationships between the organic matter production with supplemental organic fertilisers (SOF) and all the selected soil organic matter characteristics were significant, as well (Mengel and Kirkby, 2001; Dostál et al., 2006). As to the organic matter production without supplemental organic fertilisers and organic matter balance, the significant correlation coefficients were found in relation to the hydrophobicity index, only. The results are presented in Tab. V.

The most important relationships are those between organic mater need and organic carbon content, active hot water soluble carbon, total nitrogen content, infrared spectra, respectively (Fig. 1–4). All selected soil organic matter characteristics decreased with the increasing values of the organic matter need. The high OM need have connection with the low root organic matter production due to low share of perennial fodder crops. That means the direct relationships between the root organic matter production and carbon, nitrogen content and OM quality. Relationships between characteristics of soil organic matter against each other are described by Kubát et al. (2004).

Infrared absorption (IR), mainly hydrophobicity index (HI) characterising quality of the soil organic matter and partly active hot water soluble carbon content increased with increasing values of the organic matter balance (Fig. 5–8). This trend indicates a higher soil organic matter quality in soils, in which there was the organic matter balance more favourable.

On the contrary, the relationships between production and input of organic matter with supplemented organic fertilisers and the characteristics of the content of soil organic matter are mostly negative. These results can be hardly explained on the basis of the existing results and apparently will need further investigation (longer time period, higher number of soil analyses).

## CONCLUSION

Organic fertilisers contribute to the organic matter turnover on the farm level. Annual turnover of organic matter (OM) in arable soils is estimated to amount 3.5 to 4.5 $t.ha^{-1}$ in the Czech Republic. About a half of this amount is saturated by crop residues being decomposed during the vegetation period and with the post harvest residues. The rest of it, about 1.5 to 2.0 $t.ha^{-1}$ annually is recommended to be supplied with farm and organic fertilisers. The long-term organic matter balance investigations in Ústí

I: *Average density of farm animals (animal units, AU) in individual districts in the Czech Republic (Czech Statistical Office, 2000)*

| AU per 1 ha agricultural land | Districts in the Czech Republic |
|---|---|
| 0.0–0.1 | Praha-město |
| 0.1–0.2 | Praha-západ, Sokolov, Chomutov, Most, Teplice, Ústí n. Labem, Brno-město, Karviná |
| 0.2–0.3 | Kladno, Mělník, Praha-východ, Rakovník, Cheb, Karlovy Vary, Tachov, Česká Lípa, Děčín, Jablonec n. Nisou, Liberec, Louny, Bruntál, Ostrava-město |
| 0.3–0.4 | Kolín, Mladá Boleslav, Nymburk, Český Krumlov, Plzeň-město, Litoměřice, Trutnov, Brno-venkov, Břeclav, Zlín, Hodonín, Vyškov, Znojmo, Frýdek-Místek, Šumperk + Jeseník, Vsetín |
| 0.4–0.5 | Benešov, Beroun, Kutná Hora, Příbram, Prachatice, Tábor, Plzeň-jih, Plzeň-sever, Chrudim, Náchod, Pardubice, Blansko, Kroměříž, Prostějov, Uherské Hradiště, Olomouc, Opava, Přerov |
| 0.5–0.6 | České Budějovice, Jindřichův Hradec, Pelhřimov, Písek, Strakonice, Klatovy, Rokycany, Havlíčkův Brod, Hradec Králové, Jičín, Rychnov n. Kněžnou, Semily, Svitavy, Jihlava, Třebíč, Nový Jičín |
| 0.6–0.7 | Domažlice, **Ústí nad Orlicí,** Žďár nad Sázavou |

II: *Proportion of crops in crop rotations and organic matter resources in Ústí nad Orlicí district*

| Year | Proportion of crops in crop rotations (%) | | | Share of the organic matter resources (%) | |
|---|---|---|---|---|---|
| | Grain crops | Root crops and annual fodder crops | Perennial fodder crops on arable land | Farm manures | Supplemental organic matter resources |
| 1991 | 51.8 | 27.8 | 20.4 | 78.8 | 21.2 |
| 1992 | 57.7 | 21.4 | 20.9 | 91.9 | 8.1 |
| 1993 | 54.0 | 22.8 | 23.2 | 96.4 | 3.6 |
| 1994 | 61.4 | 17.0 | 21.6 | 88.4 | 11.6 |
| 1995 | 58.9 | 19.1 | 22.0 | 85.4 | 14.6 |
| 1996 | 55.9 | 22.1 | 22.0 | 86.8 | 13.2 |
| 1997 | 59.2 | 23.0 | 17.9 | 80.9 | 19.1 |
| 1998 | 58.9 | 23.8 | 17.4 | 80.2 | 19.8 |
| 1999 | 56.7 | 24.8 | 18.5 | 82.1 | 17.9 |
| 2000 | 60.7 | 20.8 | 18.5 | 79.9 | 20.1 |
| 2001 | 61.1 | 21.7 | 17.2 | 79.2 | 20.8 |
| 2002 | 60.8 | 23.3 | 15.9 | 68.7 | 31.3 |
| 2003 | 62.3 | 22.9 | 14.8 | 64.3 | 35.7 |
| 2004 | 62.5 | 22.0 | 15.5 | 61.5 | 38.5 |
| 2005 | 61.9 | 21.7 | 16.4 | 60.5 | 39.5 |
| 2006 | 62.5 | 22.0 | 15.5 | 67.7 | 32.3 |
| 2007 | 66.3 | 16.3 | 17.4 | 63.1 | 36.9 |

nad Orlicí district have shown that the effort given to the production, storage and application of farm and organic fertilisers affects the level of the crop production and soil fertility, as well. The methodology of the organic matter balance estimation proved to be effective and it can be recommended for broader practical use.

The calculated need of organic matter to be supplied (average for the region) slightly differed during the last decade. It ranged from 1.156 $t.ha^{-1}$ in

III: *Results of organic matter balance in Ústí nad Orlicí district (t OM.ha$^{-1}$ arable land)*

| Year | Need of OM to be supplied with organic fertilisers | Total production of OM in organic fertilisers | In that: | | Resulting OM balance |
|---|---|---|---|---|---|
| | | | OM from farm fertilisers | OM from supplemental organic fertilisers | |
| 1991 | 1.43 | 2.01 | 1.58 | 0.43 | + 0.58 |
| 1992 | 1.16 | 1.92 | 1.77 | 0.16 | + 0.76 |
| 1993 | 1.14 | 1.72 | 1.65 | 0.06 | + 0.58 |
| 1994 | 1.15 | 2.01 | 1.77 | 0.23 | + 0.86 |
| 1995 | 1.16 | 2.11 | 1.80 | 0.31 | + 0.95 |
| 1996 | 1.36 | 2.12 | 1.84 | 0.28 | + 0.76 |
| 1997 | 1.51 | 2.05 | 1.66 | 0.39 | + 0.54 |
| 1998 | 1.51 | 2.01 | 1.62 | 0.40 | + 0.50 |
| 1999 | 1.51 | 2.02 | 1.65 | 0.37 | + 0.51 |
| 2000 | 1.45 | 2.17 | 1.73 | 0.44 | + 0.72 |
| 2001 | 1.51 | 2.29 | 1.82 | 0.47 | + 0.78 |
| 2002 | 1.56 | 2.36 | 1.62 | 0.74 | + 0.80 |
| 2003 | 1.60 | 2.69 | 1.73 | 0.96 | + 1.09 |
| 2004 | 1.53 | 2.71 | 1.67 | 1.04 | + 1.18 |
| 2005 | 1.57 | 2.82 | 1.71 | 1.11 | + 1.25 |
| 2006 | 1.52 | 2.37 | 1.60 | 0.77 | + 0.85 |
| 2007 | 1.44 | 2.55 | 1.61 | 0.94 | + 1.11 |

1992 to 1.604 in 2003. Thanks to a relative high density of farm animals (0.6 to 0.7 cattle units per 1 ha agricultural land), organic fertilisation is rather stable and the organic matter balance was more or less positive in all crop rotations. The highest value of the organic matter balance was determined in 1994 and 1995, when there was the lowest need for organic matter. In this period, the farm manures production was the highest, too. Since 1995, the highly positive organic matter balance diminished (by 53% in 1998). Input of organic matter with organic fertilisers calculated per 1 ha arable land was as follows: 1.20 t OM.ha$^{-1}$ farm yard manure, 0.12 t OM.ha$^{-1}$ poultry manure, 0.34 t OM.ha$^{-1}$ cattle and pig slurry, 0.85 t OM.ha$^{-1}$ straw, 0.13 t OM.ha$^{-1}$ green manure and 0.018 t OM.ha$^{-1}$ composts and sewage sludge annually (during 2002–2007). The average annual nutrient supply by means of farm and organic fertilisers amounted 73.8 kg N, 42.4 kg $P_2O_5$ and 75.5 kg $K_2O$ which is 191.7 kg nutrients in total per 1 ha arable land.

The relationships between the organic matter supply with supplemental farm and organic fertilisers and all the selected soil organic matter characteristics were statistically significant. Significant correlations were also found for the relationships between the organic matter need and all the selected soil organic matter characteristics and also between the organic matter balance and the soil organic matter quality.

## SOUHRN

### Hodnocení dlouhodobých bilancí organických látek a jejich vztahy k obsahu organického C v půdách na okrese Ústí nad Orlicí

Bilance organických látek byla v zájmovém území okresu Ústí nad Orlicí sledována od r. 1979. Cílem bylo stanovit potřebu organického hnojení. Dlouhodobě bylo sledováno množství organických látek ve statkových hnojivech (hnůj, kejda) i v doplňkových zdrojích organických látek (sláma, zelené hnojení). Bylo sledováno téměř 45 % orné půdy okresu Ústí nad Orlicí.

Vedle bilance organických látek bylo v půdních vzorcích sledováno několik charakteristik půdní organické hmoty (obsah organického C, N a S, obsah C rozpustného v horké vodě, index hydrofobicity vypočtený z DRIFT spekter, přístupné obsahy P, K, Ca a Mg, hodnota půdní reakce).

IV: *Differences in organic matter (OM) balances in crop rotations in the investigated territory*

| Year | Crop rotations with negative OM balance (< 0 t OM.ha$^{-1}$ arable land) | | Crop rotations with slightly active OM balance (0–0.3 t OM.ha$^{-1}$ arable land) | | Crop rotations with active OM balance (> 0.3 t OM.ha$^{-1}$ arable land) | |
|---|---|---|---|---|---|---|
| | % of acreage | number | % of acreage | number | % of acreage | number |
| 1991 | 5 | 3 | 29 | 9 | 66 | 17 |
| 1992 | 8 | 4 | 10 | 4 | 82 | 20 |
| 1993 | 15 | 2 | 26 | 4 | 59 | 17 |
| 1994 | 0 | 0 | 21 | 4 | 79 | 19 |
| 1995 | 3 | 1 | 14 | 2 | 83 | 20 |
| 1996 | 6 | 1 | 20 | 5 | 74 | 18 |
| 1997 | 21 | 3 | 14 | 2 | 65 | 19 |
| 1998 | 13 | 4 | 22 | 5 | 65 | 16 |
| 1999 | 15 | 3 | 23 | 5 | 62 | 16 |
| 2000 | 1 | 1 | 34 | 7 | 65 | 16 |
| 2001 | 3 | 1 | 40* | 6* | 57* | 17* |
| 2002 | 8 | 1 | 36* | 6* | 56* | 17* |
| 2003 | 0 | 0 | 39* | 7* | 61* | 17* |
| 2004 | 3 | 1 | 41* | 7* | 56* | 16* |
| 2005 | 2 | 1 | 38* | 7* | 60* | 15* |
| 2006 | 3 | 1 | 54* | 10* | 43* | 12* |
| 2007 | 1 | 1 | 33* | 6* | 66* | 16* |

* Since 2001, a new limit between the slightly and the sufficiently active OM balance has been used, not including supplemental organic fertilisers (straw, green manure, compost). This limit was set to > 0 t OM.ha$^{-1}$ arable land.

V: *Correlation coefficients between long-term organic matter (OM) balances and selected characteristics of the soil organic matter in the soil samples from the 240 localities, during 2002–2007*

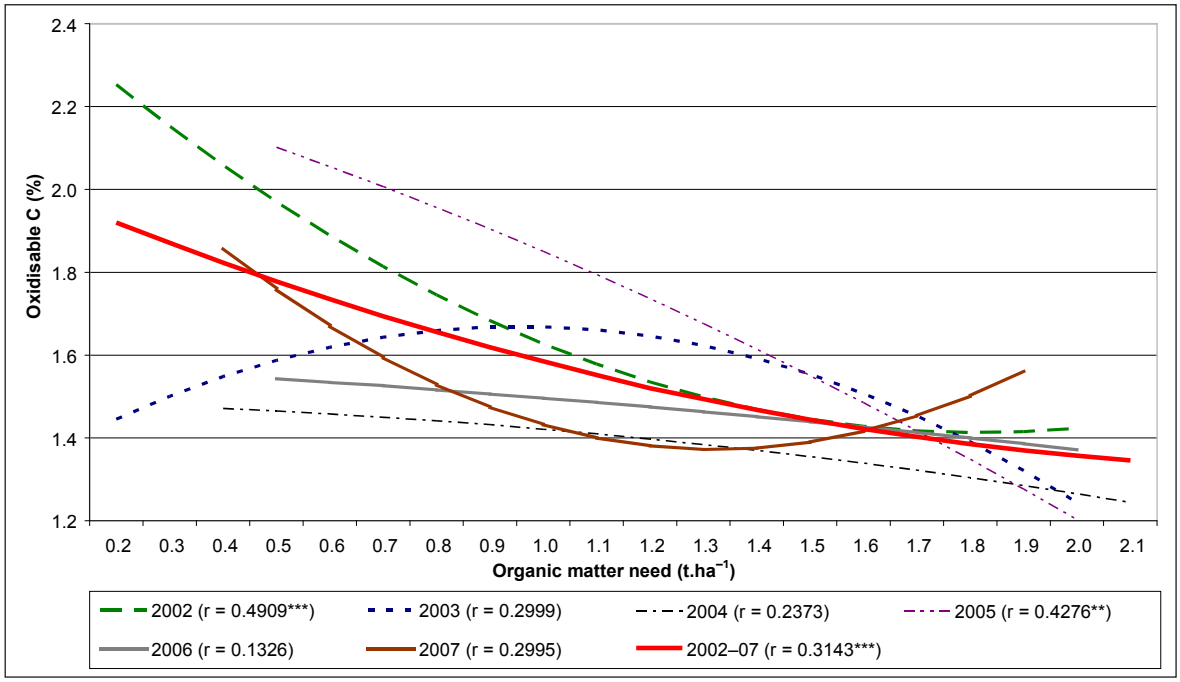
| OM production and balance | Soil organic matter characteristics | | | | | | |
|---|---|---|---|---|---|---|---|
| | Cox | Ct Leco | Nt Leco | St Leco | Chwl | IR | HI |
| OM need | 0.314*** | 0.222*** | 0.225*** | 0.142* | 0.347*** | 0.373*** | 0.133* |
| OM production witthout SOF | 0.117 | 0.116 | 0.158* | 0.118 | 0.075 | 0.086 | 0.300*** |
| OM production with SOF | 0.239*** | 0.183** | 0.233*** | 0.092 | 0.149* | 0.089 | 0.205** |
| OM balance with SOF | 0.134* | 0.144* | 0.177** | 0.116 | 0.086 | 0.137* | 0.314*** |

SOF = supplemental organic fertilisers (straw, green manure, compost)
Cox = oxidable C content
Ct Leco = total C content
Nt Leco = total N content
St Leco = total S content
Chwl = hot water soluble C content
IR = IR spectra
HI = hydrophobicity index

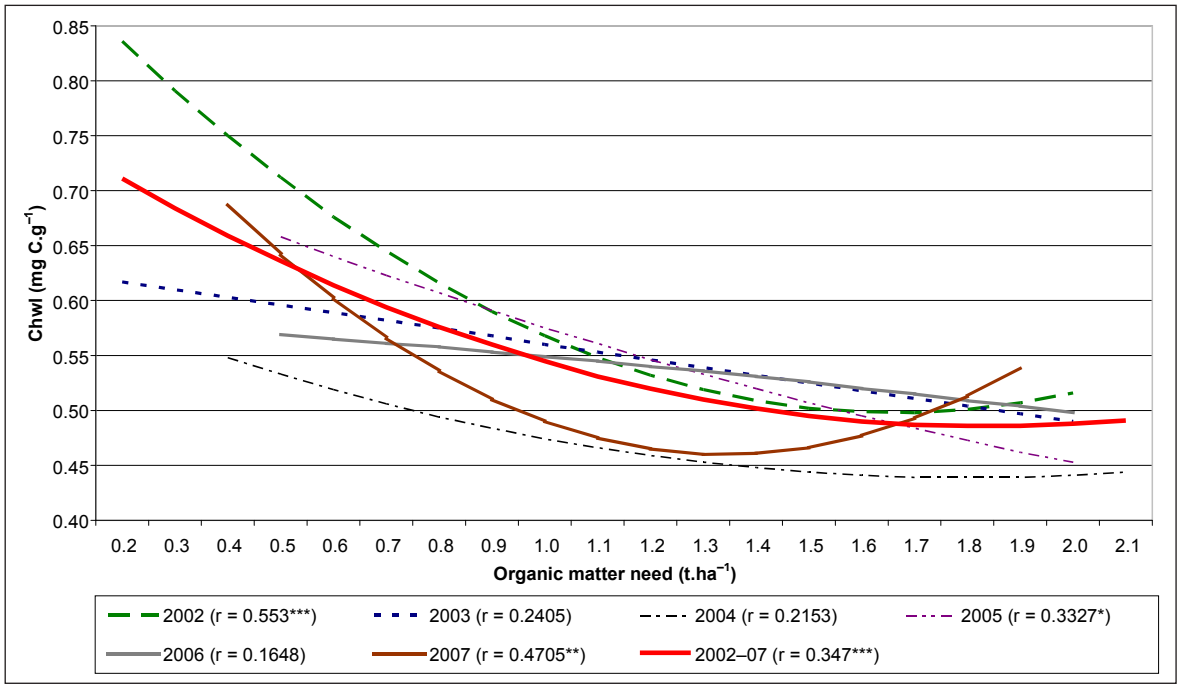
Correlation coefficients for polynom $Y = a_o + a_1X + a_2X^2$ (limit $*\mathbf{r}_{0,05} = 0{,}129$, $**\mathbf{r}_{0,01} = 0{,}169$, $***r_{0,001}$)

Statisticky významný byl vztah mezi přívodem organických látek včetně doplňkových zdrojů a všemi vybranými charakteristikami půdní organické hmoty. Statisticky významná korelace byla rovněž nalezena mezi potřebou organických látek a vybranými půdními charakteristikami. Stejně tak byla zjištěna významná korelace mezi bilancí organických látek a kvalitou organických látek.

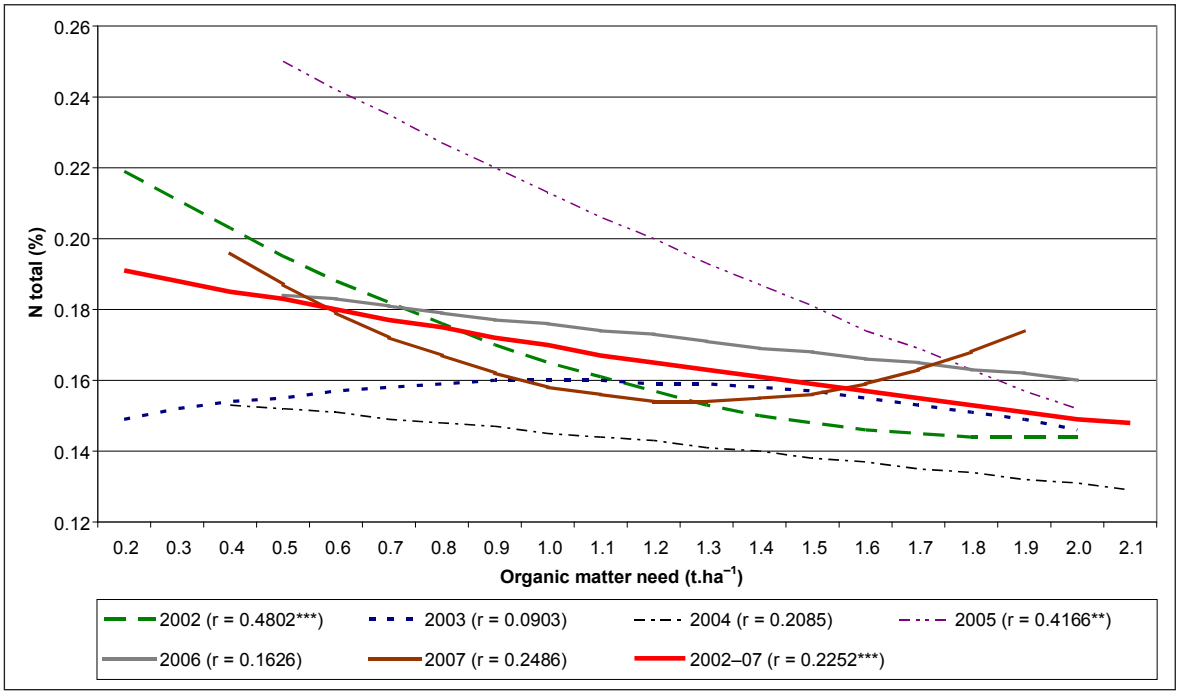
půdní organická hmota, statková hnojiva, organická hnojiva, zemědělské systémy



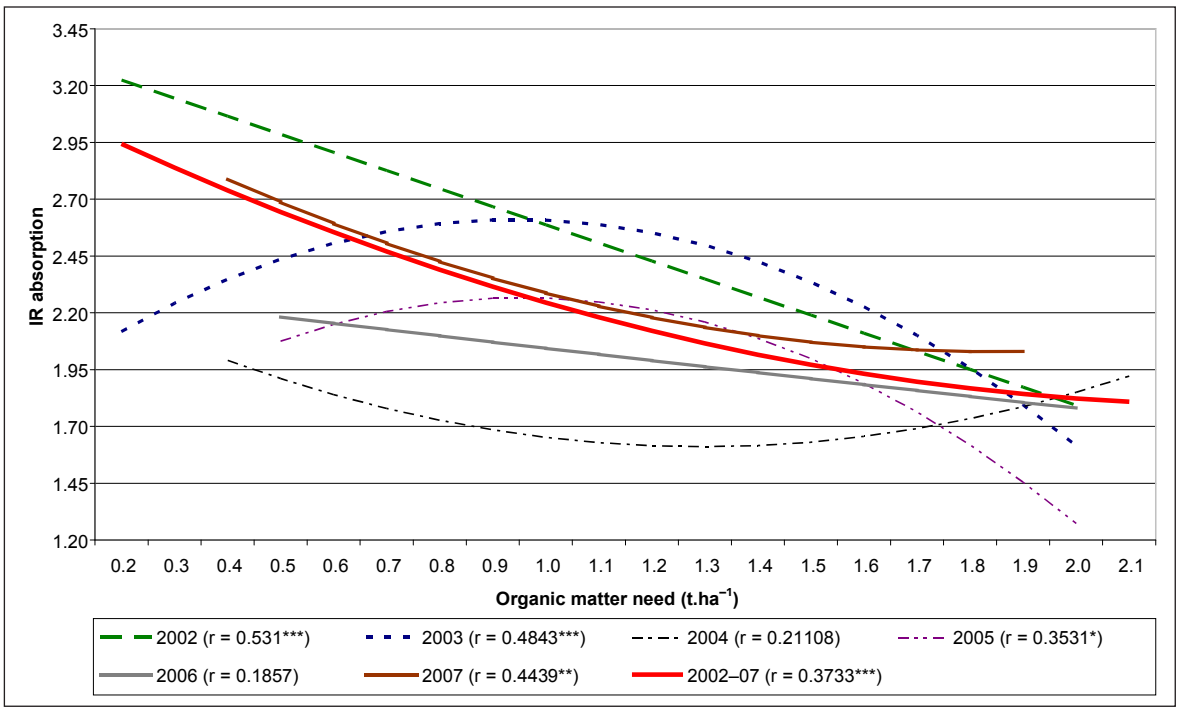

1: *Relationships between organic matter need and total oxidisable C content*



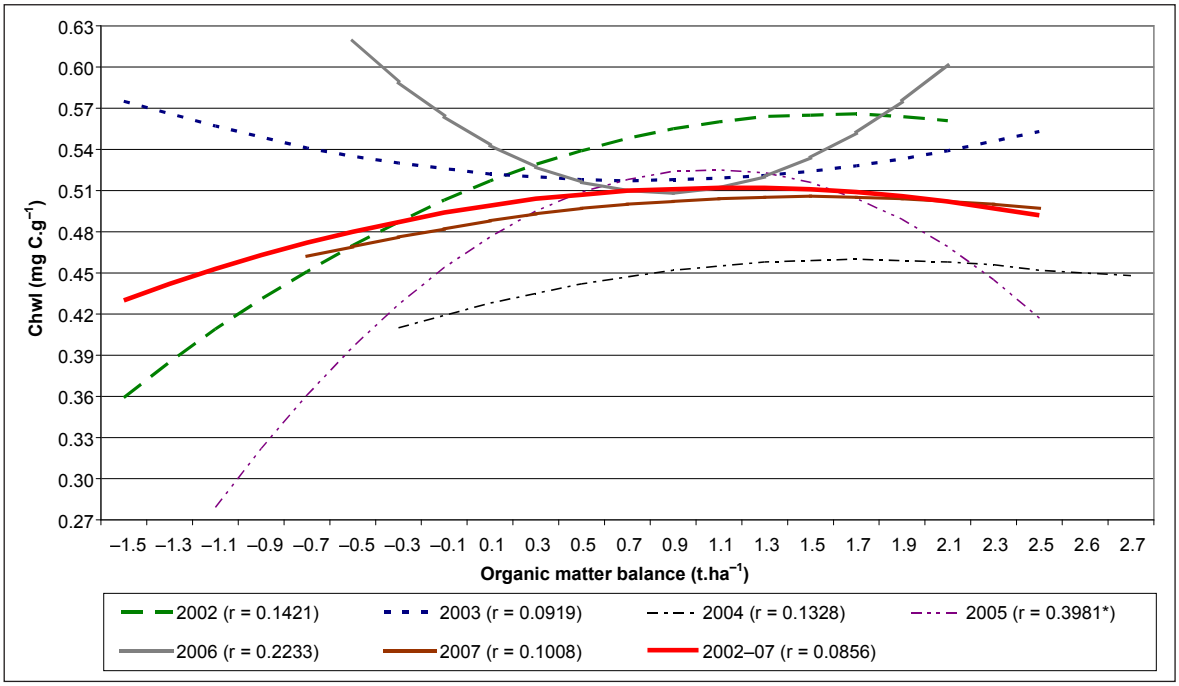

2: *Relationships between organic matter need and hot water soluble C content*



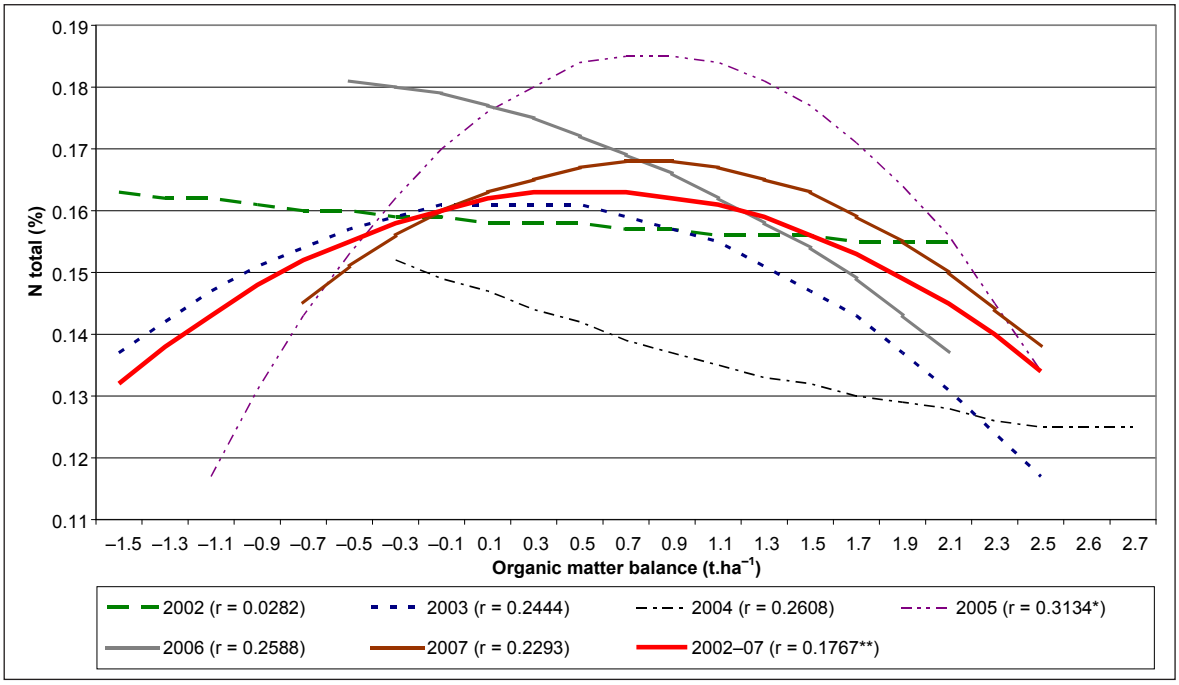

3: *Relationships between organic matter need and total N content*



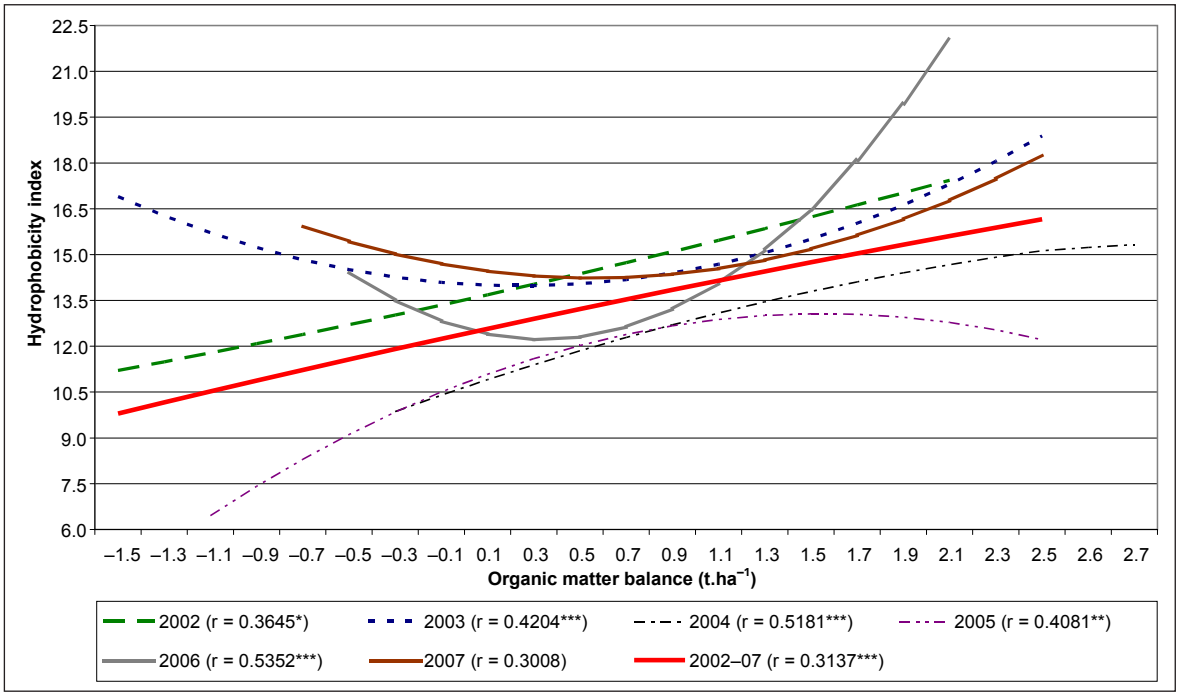

4: *Relationships between organic matter need and IR absorption*



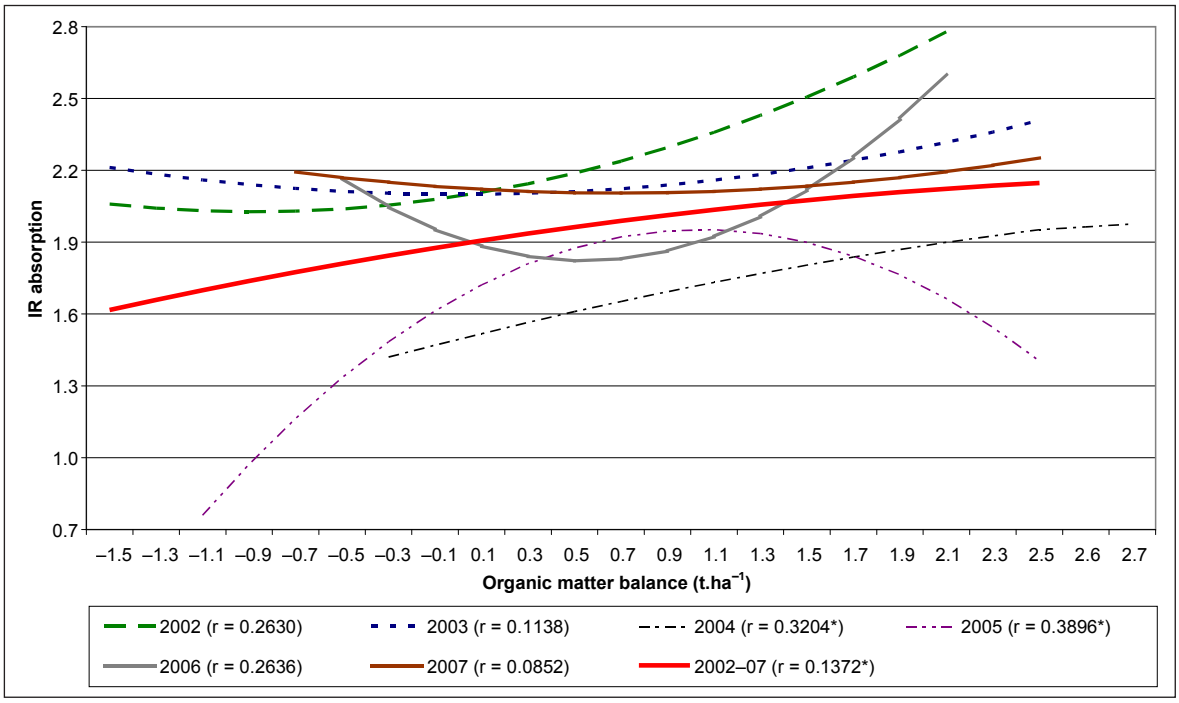

5: *Relationships between organic matter balance (with SOF) and hot water soluble C content*




6: *Relationships between organic matter balance (with SOF) and total N content*




7: *Relationships between organic matter balance (with SOF) and hydrophobicity index*




8: *Relationships between organic matter balance (with SOF) and IR absorption*

This work was funded by the project granted by the Ministry of Agriculture, Czech Republic, QG50070 and by the Research Plan No. MSM6215648905 "Biological and technological aspects of sustainability of controlled ecosystems and their adaptability to climate change", which is financed by the Ministry of Education, Youth and Sports of the Czech Republic.

## REFERENCES

ALTEN, F., WANDROWSKI, B. and KNIPPENBERG, E., 1935: Beitrag zur Humusbestimmung. *Ergeb. Agrikulturchemie*, IV B: 61–69.

CAPRIEL, P., BECK, T., BORCHERT, H., GRONHOLZ, J. and ZACHMANN, G., 1995: Hydrophobicity of the organic matter in arable soils. *Soil Biol. Biochem.*, 27: 1453–1458.

CAPRIEL, P., 1997: Hydrophobicity of organic matter in arable soils: Influence of management. *European Journal of Soil Science*, 48: 457–462.

Czech Statistical Office Report (2000) (in Czech)

DOSTÁL, J., 2002: Results of the long-term organic matter balance investigations in Ústí nad Orlicí district and the trends in the whole Czech republic. *Arch. Acker Pfl. Boden.*, 48: 155–160. ISSN 0365–0340

DOSTÁL, J., KUBÁT, J. and KLÍR, J., 2003: Results of the long-term organic matter balance investigations in Ústí nad Orlicí district and the trends in the whole Czech Republic. In: VOŘÍŠEK, K. (ed.) *Practical Solutions for Managing Optimum C and N Content in Agricultural Soils II, Proceedings of Int. Workshop*, Praha: 70–78. ISBN 80–86555–26–7

DOSTÁL, J., CERHANOVÁ, D., MARTINCOVÁ, J., KRATOCHVÍL, J. and KUBÁT, J., 2006: Results of the long-term evaluation of the organic matter balance and its relations to the organic C content in the topsoils in Ústí nad Orlicí district. In: VOŘÍŠEK K. (ed.) *The role of long-term field experiments in agricultural and ecological sciences and Practical soultions for managing optimum C and N content in agricultural soils III. Proc. Int. Conf.*, Prague: 41–48. ISBN 80-213-1454-0

KUBÁT, J., CERHANOVÁ, D., NOVÁKOVÁ, J., KLEMENT, V., ČERMÁK, P. and DOSTÁL, J., 2004: Total organic C and its decomposable part in arable soils in the Czech republic. *Archives of Agronomy and Soil Science*, 50: 21–32.

MENGEL, K. and KIRKBY, E. A., 2001: *Principles of Plant Nutrition*. 5th Edition, Kluwer Academic Publishers, Dordrecht / Boston / London, 849 p.

NEUBERG, J., et al., 1990: *Komplexní metodika výživy rostlin* (A complex methodology of plant nutrition, in Czech). ÚZPI, Praha, 327 p.

SCHULZ, E., 1997: Charakterisierung der organischen Bodensubstanz (OBS) nach dem Grad ihrer Umsetzbarkeit und ihre Bedeutung für Transformationsprozesse für Nähr- und Schadstoffe. *Archives of Agronomy and Soil Science*, 41: 465–483

Address

Ing. Jiří Dostál, CSc., Ing. Lenka Hajzlerová, Ing. Jana Martincová, Mgr. Petra Pospíšilová, AGROEKO Žamberk, Ltd., Zemědělská 1004, 564 01 Žamberk, Česká republika, e-mail: agroeko@zamberk-city.cz, Ing. Dana Cerhanová, Ph.D., Výzkumný ústav rostlinné výroby, Drnovská 507, 161 06 Praha 6, Česká republika, e-mail: cerhanova@vurv.cz, doc. Ing. Eduard Pokorný, Ph.D., doc. Ing. Tomáš Lošák, Ph.D., Ústav agrochemie, půdoznalství, mikrobiologie a výživy rostlin, Mendelova zemědělská a lesnická univerzita v Brně, Zemědělská 1, 613 00 Brno, Česká republika, e-mail: pokorny@node.mendelu.cz, losak@mendelu.cz