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THE SITES WITH FULL-AREA GROUND PREPARATION BY DOZER AND DREDGER, ITS CURRENT STAGE AND REVITALIZATION IN 7TH FOREST ALTITUDINAL ZONE OF ORE MOUNTAINS, CZECH REPUBLIC

The full-area ground preparation by dozer, with apposition to rampart composed by top holorganic and partly mineral horizons and also after logging remainders, were leaded to significant degradation of soil environment. Mainly the sites with overburden to mineral layers of sponclack horizons showed contrary values of particular soil characteristics especially humus and basic saturation. Conversely important predisposition factor for revitalization of dozer enclaves was high potential reserves of nutrition and organic substances with favourable amount of ration C: N and higher amount of mineral N in organic mineral ramparts. Today full-area application of organic mineral material with long-term exposition and fermentation especially after logging remainders from ramparts could ensure optimal nutrition and minimal immobilization of N.

Keywords: full area ground preparation, Ore Mountains, nourishment balance

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Ґрунтові ділянки, суцільно оброблені бульдозером та землечерпалкою, їх сучасний стан та відновлення у 7-й лісовій висотній зоні гір Оре, Чеська Республіка

Мета даної наукової роботи – вивчити вплив органічних речовин на стан ґрунту та на лісовідновлення.

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Повна обробка ґрунтів у 7-й лісовій висотній зоні на плато гір Оре, головним чином, проводиться на кислотних ділянках. Такі ділянки мають дефіцит органічних речовин після обробки поверхні бульдозером, а також в ямах в разі обробки землеробською. Дикоростучий деревостан посилює дефіцит органічних речовин. Це викликає проблеми у лісовідновленні. Потенційно високе постачання органічного матеріалу з бажаним N: C співвідношенням, велика кількість збалансованого гумусу і загальна кількість N могли би ефективно застосовуватись у відновленні таких ділянок. Кількість N у валах приблизно в два-чотири, а іноді і в п'ять разів вища, ніж у тонких прошарках гумусу на ділянках, оброблених бульдозером. Вирішальним фактором у випадку використання валів у відновленні ґрунтової екології є також насичення тіла валів поживними речовинами від 400 до 700 ммол/кг⁻¹. Кількість іншого живлення в пластах валів коливається в екологічному оптимумі.

Ключові слова: суцільна обробка ґрунтів, гори Оре, баланс живлення.

Introduction

Wooded areas with much more diverse species composition (beech (*Fagus sylvatica* (L.)), maple (*Acer* sp.), rowan (*Sorbus* sp.), Norway spruce (*Picea abies* (L.) Karsten originally covered Ore Mountains (west Czech Republic) Forest types are dominated by oligotrophic acidophytes in elevation 850-1000 m, soil types are presented by modal podzols to modal – ferric podzol or oligotrophic cryptopodzol. Forest critical damage led to its devastation in short time period and also forced immediate solution of problem. Liming was conducted by full area preparation considered as very raw interference into Norway spruce soil environment in the area of plateau.

Basic macroelements cycling above all N were significantly disturbed by full area stripping of holorganic and organ mineral. Climate and geomorphologic factors influence incensement of temperature inversion and next to the air pollution have significant influence on forest ecosystem components [1].

Existing substitute tree species in nowadays can provide effective ecological cover. There is possibility to create optimal growing conditions contra microclimatic stresses for example beech in its juvenile stage [2]. Beside affected stand analysis was stated that damage is caused by complex partaken by climatic inversion, seed origin and short time impact of pollution [3]. Some reasons can origin in edatope that was under pollution influence and especially influenced by different anthropogenic arrangements, for example full area deforestation related with foliar damage caused by air pollution, full area soil preparation and also exuberance of aerial liming.

Some studies proved high correlation between N deficit and level of discoloration on the Ore Mountains sites. Optimal N nutrition on studied site was ensured in case some Blue spruce (*Picea pungens* Engelm.) individuals by enriched soil solution from floating oranomineral ramparts, optionally intervening root system into these ramparts [4].

Humus forms with low quality humus and its initial stadium on sites with full area preparation does not secure optimal nourishment especially N as result juvenile stands typical discoloration appears. Liming disclosure more or less sterile illuvial horizons can lead to long-term N deficiency. Full area discoloration is significantly related to not sufficient N nourishment as result of low balance supply N in initial stadium of humus form [5].

Methods

Examination was focused on formal sites with dozer and dredger preparation in the 7th forest vegetation belt Ore Mountains plateau. Soil type specified by subtype was defined according to Czech taxonomic soil classification system [6]. The basic geological substrate was specified and completed with site matrix. Standardized methods were used samples collection.

Mehlich II soil extract preparation for determination accessible nourishment was used. Organic carbon determination in humus was oxidize by chromatosulphuric mixture with increased temperature. Total N was determined by Kjeldahl method. Humic acids to fulvo acids ration evaluated humus quality. Sorption complex characteristics were determined in soil by Kappen method. Available nourishment in horizon H organic matter was determine by Gohler extract.

Evaluated sites characteristics

Full area dozer preparation

Site: Ptačí – Mokrá – workspace, stand 225A1m, forest type: *Fageto-Piceetum acidophilum*

Dozer sites are characteristic by disclosure organic sterile horizon B and also by humus horizon Ap initial stadium development on original horizons in soil profile. Organic material significant layers are cumulated in linear ramparts. Full area preparation by dozer was done in 1970s and 1980s. Stand: Alder, dry birch and replanted spruce also partially dry. Soil type is represented by anthropic modal podzol (matrix: mica gneiss). Ramparts are composed from humified layer (25 cm) with very vital and massive *Calamagrostis villosa* stand and tessellated laid layers of mineral soil with organic material with similar ration as compost (85 cm).

Site: Špičák – workspace, stand 184 B2, forest type: *Fageto-Piceetum acidophilum*

Formal dozer site (22 year ago), recent management by mulch-laying cutter used on rampart, soil type antropic modal podzol (matrix: mica gneiss and mica schist). Stand: birch (15 years) and blue spruce (15 years). Organomineral material mixture of humic soil is placed into original Bs horizon with initial stadium of sod with chips (birch and blue spruce). Rampart residues composed by more fine structure organic matter (30 cm) with cca 20 % birch chip and original logging residues. Next organic layer (40 cm) contains cca 15 % mineral fraction, original-logging residues from workspace (20 %).

Site: Přísečnice – Jelení vrch, stand 101 A2a, forest type: *Fageto-Piceetum acidophilum*

Formal dozer site (17 year ago), recent management by mulch-laying cutter used on rampart, soil type antropic ferrous modal podzol (matrix: mica schist). Workspace is defined by irregular distribution of humus and fallowed by original mineral layer. Ramparts are characterized by higher amount of mineral fraction with homogenized humus up to 22 cm; next layer is more ore less sandy loam with very irregular addition of organic matter and humus (to 72 cm).

Dredger soil preparation into hillock

Site: Mokřiny, stand 225A2a, forest type: *Fageto-Piceetum acidophilum*

Plateau thinly stocked by blue spruce, partly dry birch, preparation was done 5 to 10 years ago, matrix – mica schist. Site is divided into habitats with fill hillocks and pits with removed holorganic horizons, organomineral and mineral horizons fill into hillocks with soil type antropic modal podzol, slightly deep gleying. Pits are characterized by removed humus and upper part of organomineral layer. Secondary sod composes horizon (0-6 cm) without humus accumulation. Hillock profiles created by dredger are mainly composed by cumulated humus horizon with cca 20-30 % mineral fraction, to 25-40 cm on partly disturbed upper organomineral layers.

Site: U Apolény – Perštejn, stand 315 A2b, forest type: *Piceetum variohumidum oligotrophicum*

Site after dredger preparation 10 year ago, stand – die back birch, matrix – quartz gneiss, soil type antropic modal pseudogley. Pits have only 4 cm humus enriched layer. Pseudogley original horizons sequence follows. Fill hillocks are characterized by accumulated humified material up to 30 cm followed by sequence of 10-15 organomineral mixture.

Results and discussions

1st and 2nd age category (20 to 40 years) stands in the Ore Mountains plateau 7th forest vegetation belt are result of high immision load in 1970s and 1980s. Rapid increase started in 1975 carried high concentrations until 1990s. There was high percentage of land ameliorated by dozer preparation on large areas where "toxic" soil layer was removed; locally to mineral layer Bs. Organomineral matter with logging residues was relocated into linear ramparts. Ramparts were stabilized to 2,5m high. Used technology removed totally organic matter as only source of N in forest ecosystem. Additionally, humus fraction at that time had optimal almost over standard requirements for its quality [1]. There were huge nutrition losses in case of mor and mor-moder humus forms and caused total N deficiency in soil environment. Only initial stadium of humus forms developed as result of liming. Organic matter is declined faster and based on liming are losses even higher [7]. High quality material with organic compound dominance was accumulated into ramparts.

There were several liming cycles until nowadays. Major proportion of sites with full area soil preparation is still very unsatisfactory. Dominating forest types *Fageto-Piceetum acidophilum* and *Abieto-Piceetum variohumidum acidophilum* are from point of view represented soil types and its chemical parameters in significant imbalance.

Ramparts on sites can have very important influence on revitalization because material was during long time period composted. Humus amount, especially its balance supply is high (more than 20 % of humus in case of cca 40 cm organic layer depth). Spreading into workspaces and consecutive placement by milling can have very positive influence on commercial forest productivity regeneration.

Especially **C: N ration** evaluated organic matter quality in those ramparts. Except one site (184 B2a) are all locations on optimum level (to 25). There is not danger of significant influence on nourishment rations due to more intensive N immobilization. There are also favorable values of mineral N. In case of mentioned technology use there should not be done any liming.

With the humus amount are closely related values of **maximum sorption capacity** that is even 2,5 times increasing with its amount and in case of spreading ramparts and actual increase T can significantly increase buffering capacity of treated workspaces. Value $300 \text{ mmol} \cdot \text{kg}^{-1}$ on treated sites is high and ensures significant buffering capacity against actual anthropogenic degradation processes in region.

Soil reaction is running in levels that does not respond acid forest types. For soils with significant podzol type are typical low values of pH/KCl and basic saturation in upper soil horizons. pH/KCl values in ramparts are remaining same even though intensive over ground liming due to significant buffering capacity with maximal sorption capacity exceeding $500 \text{ mmol} \cdot \text{kg}^{-1}$. pH/H₂O on workspaces is significantly higher (cca 4,5-6,4 pH) than in ramparts that have mainly value 2,8-3,2 pH/H₂O.

Nourishment content on selected sites was evaluated on full areas with specific aspect to nourishment content in horizon Ap on dozer sites inside workspaces and in horizon O in ramparts. Due to different research techniques were both methods evaluated according to different classification criteria.

Potassium in upper soil layers was on level optimal supply. Its amount on almost all sites was on level mid higher supply (cca $70\text{-}80 \text{ mg} \cdot \text{kg}^{-1}$) on workspaces. K values on these sites are favorable, but global balance supply especially in shallow horizon (4-6 cm) is very low. Contrary, in deep organic horizon in ramparts is balance supply very high and optimal in horizon Op1. Defraying organic layer into topsoil layer leads to total improvement of potassium amount. Its values increase from 15 to $20 \text{ mg} \cdot \text{kg}^{-1}$ K in milling prepared plough layer in depths 5-25 cm.

Calcium although full area reclamation aerial liming was done on some sites it is reaching low supply level. It is significantly increasing on other sites. Values $1600 \text{ mg} \cdot \text{kg}^{-1}$ are reaching lower locations rich sties levels with full area agriculture maintenance. Also relatively lower amount $200\text{-}400 \text{ mg} \cdot \text{kg}^{-1}$ on site Špičák is considered optimal and for given forest type and Ore Mountains is rather medium high. Liming influence can be seen on all evaluated sites with full area and dredger soil preparation. It is decreasing rapidly in next horizon Bs on workspace. Acid metamorphosis formation and podzolization processes occur even in depth from 10-15 cm and higher and Ca decrease on very low and low values level (to $150 \text{ mg} \cdot \text{kg}^{-1}$). On site with dredger soil preparation and related created specific microrelief infundibular shapes is possible applied reclaiming material accumulation in these depressions and increase of values even deeper.

Ca amount values in mineral soil on workspaces differ from Ca concentration in body of ramparts. Top horizons can be classified (10-30 cm) into optimal supply category according to criteria for organic layer. These values appear even in mid part of ramparts. Values are very favorable from viewpoint of reformation dozer sites and do not require more adjustments according to complementation of mentioned macrobioelement.

Aerial liming significantly influences **magnesium** on these sites. The Mg fraction in used Dolomite limestone was relatively high. It appears especially on workspaces with juvenile stage of humus form in case of higher stability of MgCO₃. This fact displays as secondary risk factor in case of very high, more or

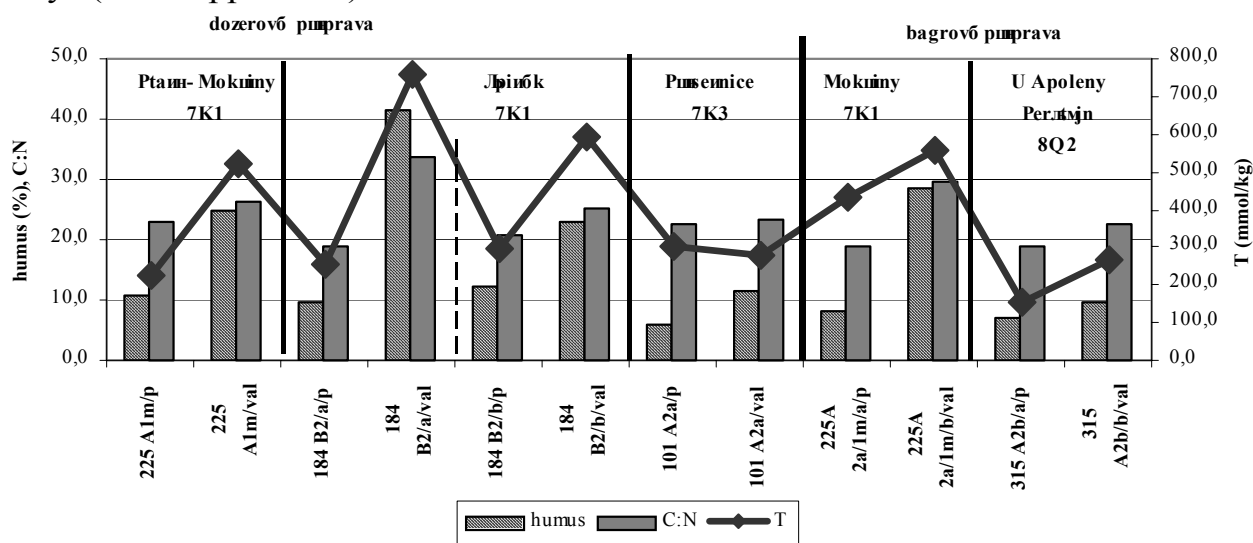
less extreme magnesium amount in topsoil layer on majority of workspaces. It can lead to nourishment blocking of some cations (K^+) next to the luxury nourishment.

Values exceeding $200 \text{ mg}\cdot\text{kg}^{-1} \text{ Mg}$ can be consider as ecologically non-natural and secondary risky on acid edaphic categories. Concentrations such as 390 mg (Ptačí – Mokřiny) and $817 \text{ mg}\cdot\text{kg}^{-1}$ (Mokřiny) lead to pH increase and as consequence increasing biological activity there is even more intensive mineralization of initial humus form. This can result to rapid migration N-mineral into lower soil horizons and consecutive deficit in N nourishment. In case of defraying spread ramparts together with very shallow horizon Ap into deeper soil layers (20-25 cm) on workspaces does not menace magnesium deficit even in case of its very low amount (under $20 \text{ mg}\cdot\text{kg}^{-1}$) in mineral horizon Bs. Higher values will conserve on sites with dredger preparation due to soil water higher level working against wash out. Selected technology by mulch-laying cutter could be used for complete revitalization to optimize available Mg amount in soil and there is not need any other secondary adjustment of soil environment. Predispositions for fractional optimization of Mg amount in soil are values measured in particular edatope sphere ahead of mechanical adjustment.

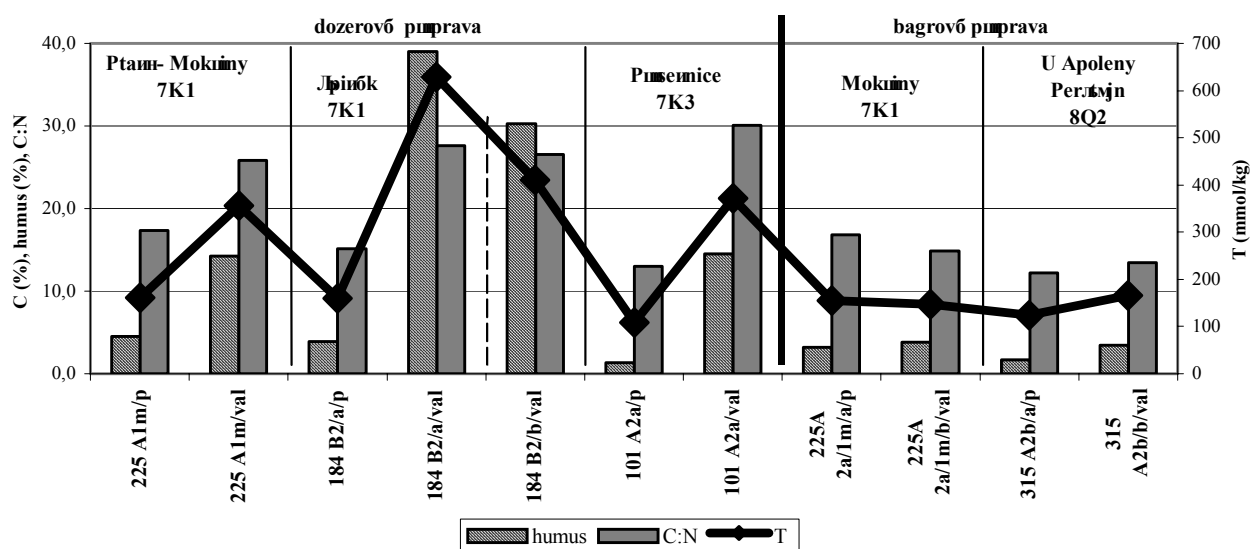
Conclusion

The full ground preparation in the 7th forest altitudinal zone of Ore Mountains plateau is mainly situated on acid, optionally water enriched sites. Podzolic soils are dominantly represented here. They do not satisfy the function of natural site with general conservancy of horizons but are degraded to appropriate anthropic variety, mainly with open sterile spodic horizon (mineral horizon). Humic layer is secondary created on the surface.

The workspaces embody significant deficiency of organic material after full area ground preparation by dozer and also in pits in case of dredger preparation. The free growing stand and also still running liming increase the deficiency of organic material. These sites can be reforestrated only with difficulties in nowadays (vide supplement).



The amount of humus, ration C: N a basic saturation in organ mineral horizon Ap (0-6 cm) and in organic horizon Op (0-30 cm) of ramparts, Ore Mountains



The amount of humus, C: N ration and basic saturation in mineral horizon Bs (6-40 cm) and in organo mineral horizon Op2 B (30-80 cm) of ramparts, Ore Mountains

The dozer sites embody very low balance of nutrition supply even they have optimal amount of macrobioelements. It is in consequence mainly to very thin layer of humic horizon Ap and followed by sterile sponck horizon Bs with extremely low amount of all basic macrobioelements.

The potential high supply of organic material with favorable C: N ration, high amount of balance humus and total amount of N can be effectively used in case of revitalization of continual areas of workspaces. The amount of N is proximally twice to forth time sometimes even five times higher in ramparts than in shallow humic horizons of original dozer sites.

The significant factor in case of use of ramparts in revitalization of soil environment is also basic saturation in body of ramparts with values running from 400 to 700 mmol.kg⁻¹. The amount of other nutrition in layers in endways ramparts range in ecological optimum.

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