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Fertilization as an ameliorative measure – examples of the research at the Faculty of Forestry and Environment CUA in Prague

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ABSTRACT: Fertilization represents a measure, used as exceptional treatment managing forest stands and ecosystems as a whole. It is used since the beginning of the 20th century worldwide, starting in the Central Europe. The beginnings were on empirical basis, later on, the scientific background was developed profoundly. Several forms and methods, as well as aims are topical at present: – Since the beginning, restoration of degraded sites and amelioration of primarily extreme soils was the aim. In the poorest regions, e.g. in the NE Germany, different means were used to increase site productivity and stability. Also in the Czech countries, amelioration played important role restoring degraded and devastated localities. – To increase site productivity, commercial fertilization was used worldwide, as well as it was applied in all continents with intense forestry practices. It became a part of the "silviculture" *sensu stricto* in the commercial, industrial forestry. – Supporting the growth and prosperity of forest plantations, on sites of different characters, was a broadly intended target of fertilizers application. – Since the air pollution calamity, fertilization is one of the main counter-treatments for improvement of the situation, lowering and preventing the soil acidification and nutritional degradation. Both direct as well as indirect methods are used. At the direct fertilization, nutrients in the fertilizers increase and improve the nutrient cycles over the degraded or natural level. This causes an increase in the forest ecosystem production as the main aim of such a treatment. In the indirect way, the amelioration material accelerates the bio-cycles by improving biological activities of the soil – liming is the best example of these activities. Nutrients are mobilized by enhanced activity of the soil biota, increasing organic matter mineralization and decay. This also represents the main ecological risk of these activities: the enormous and non-natural organic matter decay. Different types of fertilizer can be used: liquid, firm, powdered, pelletized, based on natural substances such as carbonates or silicate nutrient-rich (basic) rocks. In all cases, the uses of all these treatments have to be based on the detailed ecological analysis of the locality, of the site and of the forest stand. Only in this case, fertilizer effects can be optimized and the risks minimized.

Keywords: forest soils; degradation; amelioration; fertilization

Fertilization is a treatment employed in the forestry for a long time. Since the first concepts on nutrition importance were developed, the aims were conducted to increase site productivity of primarily poor localities and restore the degraded sites. The beginnings are registered since the early 20th century (Seibt 1977). Many experiments and practical fertilizer distributions were conducted on empirical basis, later on, the scientific results were used in more extent (Binkley 1986). The targets of these treatments changed in time and several forms and methods, as well as aims are topical at present:

1. Since the beginning of knowledge on nutrition of forest trees importance, restoration of degraded

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sites and amelioration of primarily extreme soils was the aim. In the poorest regions, e.g. in the NE Germany, different means were used to increase site productivity and stability. Also in the Czech countries, amelioration played important role restoring degraded and devastated localities (Lhotský et al. 1987).

2. To increase site productivity, commercial fertilization was used worldwide, as well as it is applied in all continents with intense forestry practices. In became a part of the "silviculture" *sensu stricto* in the commercial, industrial forestry (Binkley 1986).

3. Supporting the growth and prosperity of forest plantations, on sites of different characters, was a broadly intended target of fertilizers application (Materna 1963, 1986).

4. Since the air pollution calamity, fertilization is one of the main counter-treatments for improvement of the situation, lowering and preventing the soil acidification and nutritional degradation, as well as eliminating the nutrient deficiency of forest tree species (Podrázský, Ulbrichová 2003).

Aim of this presentation is to discuss and introduce the problems of particular topics of the fertilization, consider their potential contribution, risks and limitations and to document individual examples from the Czech Republic, especially the results of the team, member of which the author is. The examples of the research performed at the Faculty of Forestry and Environment, Czech University of Agriculture in Prague, are documented for the presentation of particular problems.

GENERAL CONSIDERATIONS

Both direct as well as indirect methods of the site amelioration are used. At the direct fertilization, nutrients in the fertilizers increase and improve the nutrient cycles over the degraded or natural level. This causes an increase in the forest ecosystem production and stability as the main aims of such a treatment.

In the indirect way, the amelioration material accelerates the bio-cycles by improving biological activities of the soil – liming is the best example of these activities. Nutrients are mobilized by enhanced activity of the soil biota, increasing organic matter mineralization and decay. This also represents the main ecological risk of these activities: the enormous and non-natural organic matter decay.

Different types of fertilizer can be used: liquid, firm, powdered, pelletized, industrial, based on natural substances such as carbonates or silicate nutrient-rich (basic) rocks. In all cases, the use of all these treatments has to be based on the detailed ecological analysis of the locality, of the site and of the forest stand. Only in this case, fertilizer effects can be optimized and the risks minimized.

1. Fertilization use potential of degraded sites

On degrades sites, fertilization is an unavoidable measure of the ecosystem restoration, considering the production as well as environmental functions of the forest. It is a predisposition of the forest vegetation establishment and survival. Sites of these types are represented by spoil banks, mining areas, and in the Czech conditions the bulldozed plots (bulldozer site preparation in the immission areas) represent a specific item. A typical bulldozed locality is represented by the research plot Boleboř (Podrázský et al. 2003) in the Krušné hory Mts. The altitude is corresponding to the 7th vegetation altitudinal zone, the site to acidic beech-spruce forest, soil type to Cryptopodzols.

Holorganic layers were almost totally removed by the bulldozer site preparation, forming windrows of 1.5 m height, 2–4 m width, in the 20–40 m distance. Humus removal led to the considerable site degradation, reflected by the tree species retardation and even decline in some cases. Table 1 documents the height growth of the Blue spruce (*Picea pungens*) on the bulldozed plot in different distance from the windrow: 1st, 2nd and 4th to 5th rows. The growth is highly suppressed with the increasing distance from the humus source, i.e. with the increasing site disturbance.

Birch represents a species growing both on windrows, both between them, on this locality. Birches

Table 1. Height growth of the blue spruce plantations in different distance from the windrow on the Boleboř locality

Height (m)/row	1	2	4–5
1988	0.93	0.91	0.67
1990	1.18	1.07	0.77
1991	1.38	1.20	0.85
1992	1.59	1.27	0.93
1993	1.87	1.48	1.03
1994	2.16	1.68	1.15
1995	2.49	1.98	1.33
1996	2.68	2.23	1.52
1997	2.92	2.42	1.68
1998	3.22	2.67	1.87
1999	3.60	2.98	2.10

showed the same decline as Blue spruce. Foliar analyses of birches in the years 1994, 1998, between rows, on rows and of declining birches between rows showed several trends:

– decrease of the nitrogen content of leaves in the period 1994–1998,
– better nitrogen nutrition on windrows, conditioned by the organic matter,
– better Ca and Mg nutrition between rows (effect of the liming), due to terrestrial liming and fertilization (not documented exactly) there in 80ies and lower buffer capacity of the scarified site,
– fall of the N-content in leaves of declining birches.

Conclusions from this experiment can be summarized as showing crucial importance of the holorganic horizons, i.e. of the surface humus in higher altitudes (since 7th vegetation altitudinal zone), further showing the site disturbance by bulldozing and indicating the importance of the nutrition improvement by biological as well as chemical amelioration. Experimental as well as practice treatments should be applied in a great extent there, but only practice aerial liming is proposed mostly (Balek et al. 2001), with some exceptions of complex fertilization.

2. Fertilization increasing productivity

Treatments of this type were minimally used in the Czech Republic, more in the past decades. As an exceptional example can serve the plots established in the years 1965–1967 on the territory of the Training School Forest of the Czech University of Agriculture in Prague in the Kostelec nad Černými lesy. This area is located 25–50 km SE from Prague. The climate is moderately warm and arid, mean year temperature is 7.6°C, average year precipitation reaches 655 mm value (Ondřejov Station). The soils are of Luvisol type, the established research plots are especially on the fir-beech sites. The set of three studied plots is on the Jevany District in the stand 442D11, in the altitude 400 m a.s.l., on very moderate SE slope, on the forest type *Luzulo-Quercetum luzuletosum pilosae*, in modern classification 3S1 (fresh oak-beech site). The soil is sand-loamy, on perm-carbonian sediments, the locality is named Aldašín (the name of the village extinct in Thirty Years' War).

The plots were established in the period 1965–1967, of 0.20–0.25 ha size, the position and dendrometric parameters were determined at individual trees. Three basic variants were defined:

– control one, without fertilizers application,
– full fertilization, NPKCa,
– nitrogen application, N.

NPKCa: commercial fertilizer, 150–200 kg of pure N/ha, 50–100 kg pure P/ha, 100 kg pure K/ha, 100–400 kg pure Ca/ha in the form of ammonium nitrate with limestone – commercial fertilizer.

N: 180–200 kg pure N/ha in the ammonium nitrate form. All application was done manually to ensure even fertilizer distribution. The experiment was stopped in 1970ies, restored in 2002. Only part of plots was conserved.

The preliminary results concerning the forest soils documented:

– Even after 35 years, the effects of fertilization are obvious, despite the soil changes are not profound;
– In the surface humus accumulation, there were not visible clear tendencies, the total nutrient content was affected by their artificial input (complex variant), the N-fertilization led more to the bases content decrease;
– In the basic soil chemistry parameters, there was obvious the effect of nutrient supply including bases at the complex variant and the acidification effect of the nitrogen fertilization;
– There is visible acidification in the 1960ies–2002 period.

In studied stands, there is (besides the acid deposition and fertilization effects) very high probability of the acidification effects of the Norway spruce monocultures cultivations and of the limitation of the root systems only to the uppermost soil (especially holorganic) horizons. One of the most important conclusions is, that fertilization by higher N-amount

Table 2. Nutrition status of the birch on sites with bulldozer site preparation on the Boleboř locality

Site type	N	P	K	Ca	Mg	Na	Zn	Cu	Mn
1994									
Between windrows	2.56	0.41	0.61	0.360	0.140	–	–	–	–
1999									
On windrows	2.94	0.191	0.992	0.449	0.1111	70	228	21	1,513
Between windrows	2.132	0.415	0.723	0.729	0.1740	62	138	20	806
Declining	1.572	0.420	0.848	0.474	0.1834	73	88	8	185

can endanger the soil state and stand stability and increase the soil acidification, and that considerable soil acidification took place also in middle and lower altitudes. Results are presented in other part of this conference.

Production of the whole stands did not change much, respectively, there is not exact evidence between years 1979–2002, but the individual tree dimensions were affected considerably (Table 3). So, the fertilization can improve the production parameters also in Mid-European conditions.

Table 3. Tree parameters on plots with different fertilization on the studied locality

Plot	13 – NPKCa	14 – N	15 – control
Tree number			
1965	1,195	1,240	1,248
1979	862	1,009	1,031
2003	515	705	905
Mean diameter (cm)			
1965	18.17	18.49	17.41
1979	21.24	21.54	20.11
2003	29.53	28.21	24.63
Height 2003 (m)	26.16	26.17	26.09
Mean tree volume (m^3)			
1965	0.229	0.238	0.206
1979	0.395	0.406	0.342
2003	0.880	0.802	0.593

3. Fertilization supporting forest plantations

The research plots were established in the vicinity of the Žďár nad Sázavou town, in the Czech-Moravian Highland in the year 1994. The altitude ranges around 580 m a.s.l., forest type is determined as 5K8 – acid fir-beech site, soil type as Cambisol. The plantations of beech were established in April 1994 as (a) plantation on the clear-cut, (b) plantation in the 50% canopy (light intensity), i.e. as underplantings. Besides of the shelter effects, the influence of the basic rocks flours was tested – or 1 kg of finally powdered limestone (Ca content 20.5%, Mg content 11.25%), or 2 kg of finely ground amphibolite per planting pit, mixed with the soil material just before planting. The healthy status of young beech plants, their damages by abiotic factors and their growth was studied in the next years.

The results documented (Tables 4 and 5) relatively favorable effects of the site amelioration, unfavorable effects of the liming on this locality and especially the highly positive effects of the shelter position on the beech. Based on these results, much better results can be expected from the natural regeneration of the beech – the shelter-wood system.

It can be concluded:

– amelioration with basic rock powders lowers the damages on the beech by the abiotic factors of the clear-cut environment as well as it lowers the plant mortality,

– effects of pure liming are only in the short-term positive, in the longer term they are mostly negative, in given conditions they disturbed the potassium and especially nitrogen dynamics, for bigger amounts of limestone (5 t/ha) it can be expected also on other sites despite of pit or surface liming,

– application of silicates was more effective and positive, comparing to the carbonates,

– the shelter position of beech plantation is crucial for its prosperity as for growth, quality and damages, lower damages by biotic factors (weeds, rodents) can be expected there too. The shelter position in the given example also eliminated the negative effects of the liming,

– in the 4^{th} to 6^{th} vegetation altitudinal zone, the under-plantings of beech can be recommended,

– the recommendation for the practice: the fertilizer application based on the nutrition analysis can improve considerably the healthy state and prosperity of the plantations, especially on sites degraded by conifer monocultures and on the more extreme sites.

4. Fertilization in immission areas

Two pairs of permanent research plots (PRP) were established for the fertilization effects study in sum-

Table 4. Damages on plantations on the Babín locality

Variant	Frost 94 (%)	Frost 97 (%)	Frost 98 (%)	Mortality 94		Mortality 94 + 95		Dead terminal 94	
				(pcs)	(%)	(pcs)	(%)	(pcs)	(%)
K – control	41	28	33	49	39	61	45	34	39
V – liming	40	27	34	36	31	53	55	20	31
A – amphibolite	30	25	28	26	26	42	38	22	26

Table 5. Height of plantations (cm) on the Babín locality on the clear-cut and in the shelter position

Variant	H 93	H 94	H 95	H 96	H 97	H98	H 99	H 00	H 01	H 02	H 03
Clear-cut											
Control 1994	20	22	29	34	37.8 a	53.6 ab	75.4 ab	106.6 ab	129.8 a	135.0 a	161.0 a
Liming	18	21	29	32	38.8 ab	53.2 a	65.5 a	101.1 a	120.8 a	109.0 a	129.0 a
Amphibolite	18	21	28	35	44.5 b	62.7 abc	89.1 bc	133.6 c	173.8 b	194.0 b	228.0 b
Underplanting											
Control	24.4	27.2	36.4	54.6	72.8 a	121.5 a	169.1 a	207.6 a	260.8 a		362.0 a
Liming	24.3	28.0	39.7	64.5	89.4 bc	138.0 bc	190.0 bc	226.4 a	288.1 bc		401.0 b
Amphbolite	24.9	28.7	43.5	70.6	98.3 c	147.8 c	204.1 c	252.4 b	302.4 c		408.0 b

Different indexes indicate statistically significant differences on the 95% significance level

Table 6. Foliation and yellowing of spruce on the studied plots on the Forest District Stožec territory in 1998–2003 (%)

Year	1998		1999		2000		2001		2002		2003	
	Fol.	Yel.	Fol.	Yel.	Fol.	Yel.	Fol.	Yel.	Fol.	Yel.	Fol.	Yel.
7. Fertilizers	80	13.0	86	9.2	82	6.5	84	9.2	71 a	1.6 a	69	1
7. Control	78	14.6	85	13.3	81	15.7	81	15.2	61 b	14.2 b	61	19
8. Fertilizers	74	17.5	72	16.4	72	15.5	73	6.4	66 c	6.9 c	71	5
8. Control	76	15.0	76	14.0	75	18.8	75	17.0	71 c	19.1 d	73	21

Different indexes labels statistically significant differences

mer 1998. Research plots are located in the Stožec Forest District area in zones II. of the National Park Šumava (plot U kanálu – 920 m a.s.l., beech-spruce vegetation altitudinal zone, forest type 7O1, stand age 44, and plot Stožec 1,230 m a.s.l., spruce vegetation altitudinal zone, forest type 8K7, stand age 107). On the both localities there were established two neighbor plots with control and fertilized variant. Fertilizers application was in summer 2000, manually, in amount 100 kg of nitrogen per hectare in the form of Silvamix Mg fertilizer. This corresponds to the application of 170 kg of MgO, 65 kg of K_2O and 130 kg of P_2O_5 per ha. Plot area is 50 × 50 m, yellowing and defoliation is observed every year in the autumn and ocular estimation method is used for this purpose, in 5% defoliation and yellowing classes (Vacek, Mayová 2000). Yellowing in this area is observed for long time here already, not reaching critical extent nor progressing into forest decline yet. In the German as well as Austrian part of this mountain range, many successful fertilization experiments were established to prevent and reduce Norway spruce yellowing and defoliation. The so-called "new type of forest decline" was described here since 1980ies and several treatment types were tested as conteraction (Hüttl 1987).

Results indicate the rapid effectiveness of the Mg supply on the yellowing suppression (Podrázský et al. 2003). This phenomenon was rapidly decreased to the negligible level and also the defoliation showed lower values (the foliation being higher on fertilized plots).

CONCLUSIONS

The possibilities of fertilizing use in the forestry are wide also in the Czech conditions and there are considerable needs for their study and practical exploitation.

1. On degraded sites, the fertilization represents a necessary part of the complex site restoration, providing conditions for any tree species prosperity and survival. It should be based on the soil/site and tree nutrition analysis and evaluation.

2. The production increase is not common aim of the fertilization treatments in the Czech Republic, there is only scattered information concerning its research and its results. But the production parameters as well as the forest soil characteristics can be affected by the soil improving treatments.

3. The forest plantations can be improved as for their vitality, quality and growth intensity, especially

on more extreme sites and using more site demanding species (e.g. beech, fir). The fertilizer type has to be analyzed for its effect – the direct fertilization is less risky comparing to the indirect (liming) one.

4. Fertilization is an effective tool to reduce the tree yellowing as well as defoliation in the immission areas. Relatively vital stands are necessary predisposition for the use of its positive effects.

It has to be emphasized, that the fertilization represents one of final forestry measures in the topical forestry concept. It is used exceptionally, where the classical forestry treatments fail or on the most extreme sites. More intense involvement of the fertilization in the forestry activities needs more analysis as well as professional and public discussion.

References

BALEK J., ŠRÁMEK V., LOMSKÝ B., 2001. Vápnění a hnojení lesních porostů v letech 2000–2001. Lesnická práce, *80*: 483.

BINKLEY D., 1986. Forest nutrition management. New York, J. Wiley: 289.

HÜTTL R.F., 1987. "Neuartige" Waldschäden, Ernährungsstörungen und Düngung. Allgemeine Forstzeitschrift, *42*: 289–299.

LHOTSKÝ J. et al., 1987. Degradace lesních půd a jejich meliorace. Praha, Státní zemědělské nakladatelství: 234.

MATERNA J., 1963. Hnojení lesních porostů. Praha, Státní zemědělské nakladatelství: 227.

MATERNA J., 1986. Změny ve výživě lesních porostů a jejich kompenzace. In: Vápnění lesních půd v imisních oblastech. Ústí nad Labem, Dům techniky ČSVTS: 8–17.

PODRÁZSKÝ V.V., REMEŠ J., ULBRICHOVÁ I., 2003. Biological and chemical amelioration effects on the localities degraded by bulldozer site preparation in the Ore Mts. – Czech Republic. Journal of Forest Science, *49*: 141–147.

PODRÁZSKÝ V., ULBRICHOVÁ I., 2003. Surface liming of immission clear-cuts: benefits and risks. Ekológia, *22*, Suplement 1: 277–283.

PODRÁZSKÝ V.V., VACEK S., ULBRICHOVÁ I., 2003. Effect of fertilization on Norway spruce needles. Journal of Forest Science, *49*: 321–326.

SEIBT G., 1977. Ergebnisse einiger Kalkdüngungsversuche in Nordwestdeutschland. Forstarchiv, *48*: 197–199.

VACEK S., MAYOVÁ J., 2000. Zdravotní stav lesních porostů na TVP v NP Šumava. In: PODRÁZSKÝ V. V. et al. (eds.), Monitoring, výzkum a management lesních ekosystémů Národního parku Šumava. Praha, ČZU: 142–152.

Hnojení jako meliorační opatření – příklady výzkumu na Fakultě lesnické a environmentální ČZU v Praze

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ABSTRAKT: Hnojení lesních půd a porostů představuje extrémní opatření, používané v mimořádných případech. Používá se na celém světě od počátku 20. století – zpočátku především na empirickém základě, později na bázi získaných a ověřených vědeckých poznatků. V současné době je aktuálních několik významných způsobů a případů využití hnojení: – Od počátku se hnojení využívalo ke zlepšení produkce porostů na primárně chudých půdách a degradovaných stanovištích. Tento způsob využití je důležitý i pro české země. – Komerční hnojení se používá na celém světě a je spojováno s intenzivním, zprůmysleněným lesnictvím. Stalo se součástí „pěstování lesů" v zemích, kde jsou tyto aktivity spojovány s intenzivními technologiemi. – Důležitým způsobem využití je podpora růstu a prosperity výsadeb na stanovištích různého charakteru. – Od počátku imisní kalamity byly různé způsoby hnojení důležitým opatřením prevence a remediace půdní acidifikace a nutriční degradace. Jsou využívány jak přímé, tak i nepřímé způsoby hnojení. Při přímém hnojení jsou aplikovány živiny, které se přímo zapojují do koloběhu látek a zintenzivňují je nad degradovanou nebo i přirozenou úroveň. To zvyšuje produkci lesního ekosystému a představuje hlavní cíl uvedeného opatření. Při nepřímém hnojení zvyšuje meliorační materiál intenzitu biologické aktivity; jako klasický příklad může sloužit vápnění. Živiny jsou mobilizovány zvýšenou aktivitou půdní bioty, mineralizací organické hmoty v půdě. To na druhé straně představuje i hlavní riziko těchto opatření: nadměrný a nepřirozený rozklad organické hmoty. Mohou být využity různé formy hnojivých materiálů (pevné, tekuté, v práškové formě, tabletované), založených na přírodních látkách, jako jsou moučky bazických hornin. Jejich použití musí být ve všech případech založeno na podrobné analýze lokality, stanoviště a lesního porostu. Pouze v těchto případech budou účinky hnojivých zásahů optimalizovány a rizika minimalizována.

Klíčová slova: lesní půdy; degradace; meliorace; hnojení

Hnojení lesních porostů a lesních půd se dostává opětovně do popředí zájmu lesnické praxe i státní správy. Používá se na celém světě od počátku 20. století, zpočátku především na empirickém základě, později na bázi získaných a ověřených vědeckých poznatků. V současné době je aktuálních několik významných způsobů a případů využití hnojení:

– Od počátku se hnojení využívalo ke zlepšení produkce porostů na primárně chudých půdách a degradovaných stanovištích. Tento způsob využití je důležitý i pro české země.

– Komerční hnojení se používá na celém světě a je spojováno s intenzivním, zprůmyslněným lesnictvím. Stalo se součástí „pěstování lesů" v zemích, kde jsou tyto aktivity spojovány s intenzivními technologiemi.

– Důležitým způsobem využití je podpora růstu a prosperity výsadeb na stanovištích různého charakteru.

– Od počátku imisní kalamity byly různé způsoby hnojení důležitým opatřením prevence a remediace půdní acidifikace a nutriční degradace.

Jsou využívány jak přímé, tak i nepřímé způsoby hnojení. Při přímém hnojení jsou aplikovány živiny, které se přímo zapojují do koloběhu látek a zintenzivňují je nad degradovanou, nebo i přirozenou úroveň. To zvyšuje produkci lesního ekosystému a představuje hlavní cíl uvedeného opatření.

Při nepřímém hnojení zvyšuje meliorační materiál intenzitu biologické aktivity; jako klasický příklad může sloužit vápnění. Živiny jsou mobilizovány zvýšenou aktivitou půdní bioty, mineralizací organické hmoty v půdě. To na druhé straně představuje i hlavní riziko těchto opatření: nadměrný a nepřirozený rozklad organické hmoty.

Mohou být využity různé formy hnojivých materiálů (pevné, tekuté, v práškové formě, tabletované), založených na přírodních látkách, jako jsou moučky bazických hornin. Jejich použití musí být ve všech případech založeno na podrobné analýze lokality, stanoviště a lesního porostu. Pouze v těchto případech budou účinky hnojivých zásahů optimalizovány a rizika minimalizována.

V příspěvku jsou uvedeny příklady aplikací hnojení při řešení jednotlivých typů problémů lesnické a ekologické praxe:

1. V prvním případě je analyzována potřeba hnojení na lokalitě degradované buldozerovou přípravou půdy. Je analyzován dopad přípravy na růst následných výsadeb přípravných dřevin (tab. 1) a na stav jejich výživy (tab. 2).

2. V dalším experimentu je dokumentován vliv tzv. komerčního hnojení na růst a produkci lesních porostů v typických podmínkách středních poloh (ŠLP Kostelec nad Černými lesy, nadmořská výška kolem 400 m, průměrné roční srážky 655 mm, průměrná roční teplota 7,6 °C, smrkové stejnověké porosty). Srovnávaly se varianty kontrolní, komplexní hnojení (NPKCa) a hnojení dusíkaté. Zásah byl realizován v letech 1965–1967, hodnocení bylo provedeno v roce 2002. Hnojení zvýšilo střední parametry lesních porostů, jeho praktické výsledky jsou však problematické (tab. 3).

3. Za další bylo hnojení aplikováno s cílem podpory kultur náročnějších lesních dřevin (BK) na lokalitě degradované pěstováním monokultur jehličnanů. Lokalita se nachází v oblasti Žďáru nad Sázavou (580 m n. m., SLT 5K8). Kultury buku byly založeny v dubnu 1994 na holině a v 50% cloně. Aplikoval se jednak jemně mletý vápenec (1 kg na sazenici), jednak jemně mletý amfibolit (2 kg na sazenici). Plocha na holině vykazovala velké poškození abiotickými faktory (obě plochy jsou oploceny), hnojení amfibolitem míru poškození výrazně snížilo (tab. 4). Hnojení zvýšilo přírůst výsadeb výrazným způsobem, mnohem významnější je však úloha clonného postavení (tab. 5).

4. V posledním případě jsou uvedeny výsledky aplikace hnojení v případě tzv. žloutnutí lesních porostů v oblasti Šumavy (7. a 8. LVS), v typických podmínkách pro tento jev. Aplikace vhodného typu hnojiva výrazně snížila až eliminovala projevy žloutnutí (tab. 6) a snížila i defoliaci porostů.

Při důkladné analýze stanovištních podmínek a jednotlivých porostů a při výběru vhodného typu hnojiva a způsobu aplikace tak může být chemická meliorace vhodným opatřením při řešení různých problémů lesního hospodářství i ochrany životního prostředí.

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