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Pechová B., Miklovič D., Bujnovský R.: **Zhodnotenie vybratých agrochemických parametrov pôdy z hľadiska jej produkčnej funkcie.**

V rokoch 1999–2001 sme vyhodnocovali úrodutvorný potenciál stredne ťažkých pôd Slovenska v rámci čiastkovej úlohy „Potenciál pôdnych živín vo vzťahu k tvorbe úrod a stratégii hnojenia“. Zistili sme, že väčšina stredne ťažkých černozemí čiernicových karbonátových, modálnych karbonátových a čiernic modálne karbonátových si stále udržuje vysoký úrodnostný potenciál z hľadiska pôdnej reakcie, množstva a kvality humusu a živinovej ponuky. K úrodným pôdam možno zaradiť aj niektoré černozeme hnedozemné, čiernice modálne, fluvizeme modálne, modálne-karbonátové a hnedozeme modálne, najmä pri vyššom obsahu N, P, K živín. Menej úrodné sú kambizeme modálne nasýtené, pseudogleje modálne nasýtené a luvizemné nasýtené. Štatisticky významné korelácie medzi pôdnymi parametrami, t.j. pôdnou reakciou, humusom, kvalitou humusu (HK:FK, C:N), celkovým dusíkom, prístupným fosforom a draslíkom objektivizuje hodnotenie úrodnostného potenciálu pôd.

INFLUENCE OF CHEMISTRY OF PRECIPITATION ON WATER SOURCES

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Abstract

Dubová M., Bublinec E.: Influence of chemistry of precipitation on water sources. Ekológia (Bratislava), Vol. 22, No. 2, 219–224, 2003.

The Slovak mountain forests situated at higher altitudes are subjected to a strong load due to the acid deposition. Because these forests represent headstreams of rivers, there is a potential danger of decreasing the water sources quality. The data of the precipitation chemistry from our database were generalised and arranged according to the vegetation and altitude zones: oak (below 400 m a.s.l.), beech (400–700 m), spruce (700–1200 m) and upper forest line (above 1200 m). The most acid precipitation has been found within 700–1200 m, with pH values 4.8 and 4.0 for open area (OA) and forest stands (ST), respectively. The deposition below 400 m is an exception. Here the inputs of nitrogen and sulphur are enormous high (agriculture, fertilisation of soils, intensive car traffic). Neglecting this zone, the acid components of deposition reach the maxims in the zone 700–1200 m (both in OA and ST). The corresponding values for OA and ST are in kg ha^{-1} $year^{-1}$: sulphate sulphur 33 and 59 kg, nitrate nitrogen 10 and 13 kg, nitrate and ammonium nitrogen about 30 kg N, fluoride 2.5 and 1.9 kg, hydrogen ion 0.1 and 0.7 kg. The inputs of acid components in the zone above 1200 m were in general higher (at least equal) compared to the zone 400–700 m. The values of nitrogen input in stands under 400 m and above 1200 m are practically the same (40 and 38 kg N ha^{-1} $year^{-1}$), at the upper tree line they were even higher than the input of sulphur (34 kg S ha^{-1} $year^{-1}$).

Introduction

The input of human made components (anthropogenic deposition) into the natural environment in forms either of dry, wet or bulk deposition is subjected to the intensive world-wide ecological study (Parker, 1984; Johnson, 1992; Šály, Pichler, 1993; Zarski et al., 1999). The abundant knowledge obtained under various natural conditions in different ecosystems (forest, aquatic, terrestrial) is summarised, examined and enable us to generalize about commonly valid principles. This contribution is focussed on the strong acid load in Slovak mountain forests situated in higher altitudes (Bublinec, Dubová, 1993). Pollution of these forests covering numerous headstreams of Slovak rivers represents a very real danger for the water sources quality in Slovakia.

Materials and methods

The Institute of Forest Ecology of the Slovak Academy of Sciences in Zvolen has been also involved in the monitoring and evaluation of acid deposition into forest ecosystems (Bublinec, Dubová, 1989; Kellerová, 1999). At present we manage a considerable data-base about the precipitation chemistry (risk element contents in precipitation) and about the anion-cation inputs into numerous observed forest ecosystems. The data have been obtained from various geographical units and from various altitudes. Several data sets represent considerably long complete time series covering 15 or even more years (Dubová, Bublinec, 1998). In addition to domestic pollution sources, the whole Slovak Republic is also exposed to the pollution due to transboundary transport of sulphur dioxide (SO_2) and nitrogen oxides (NO_x). For this reason we perform a regular precipitation monitoring on several experimental plots situated in forest ecosystems, both in open area (OA) – atmospheric precipitation - and under tree crowns in stands (ST) – throughfall (Bublinec, Dubová, 1995; Pichler, Gregor, 1994; Dubová et al., 1995).

Results

We subjected the data obtained by monitoring the acid deposition in forest stands in Slovakia to a thorough examination with the aim to find, if any, general regularities. We arranged the values according to the zones of vegetation and altitude (Table 1). The first, the lowest zone is characterised by oak and is situated under about 400 m a.s.l. It is followed by zones

T a b l e 1. Values of pH and individual constituents of acid deposition [kg ha^{-1} year^{-1}]. The maxims were in general indicated between 700-1200 m a.s.l.

Vegetation zones	Altitude [m]	n	pH		$N\text{-}NO_3^-$		SO_4^{2-}		F^-		H^+	
			OA	ST	AO	ST	OA	ST	OA	ST	OA	ST
Oaks	< 400	1	6.6	6.2	33	40	140	154	-	-	0	0
Beech	400-700	5	4.8	4.7	6	6	14	18	1.9	1.9	0.1	0.1
Spruce	700-1200	4	4.8	4.0	10	13	33	59	2.5	0.9	0.1	0.7
Upper tree line	> 1200	2	5.5	4.6	8	12	24	34	1.9	1.4	0.1	0.4

OA – open area, ST - stand (throughfall)

with dominant beech between 400 and 700 m a.s.l. and spruce from 700 to 1200 m a.s.l. The last and the highest is the zone of the upper tree line over 1200 m a.s.l.

The Table 1 presents the pH values and the values of constituents of the acid deposition having impacts on precipitation acidity. The first quantity – pH value is an immediate indicator characterising the extent of acidification. We observed the highest precipitation acidity in the case of throughfall (ST) with the maximum between 700-1200 m a.s.l. The mean pH value was 4.0 and represented the strong acid area. Figure 1 illustrates the mean pH values of throughfall determined in the individual zones of altitude.

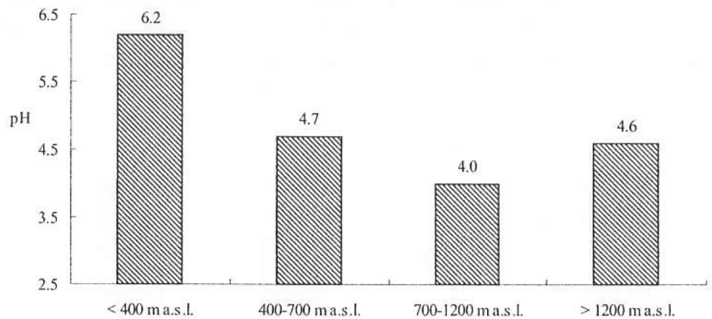

Fig. 1. Mean pH values of throughfall in the individual zones of altitude.

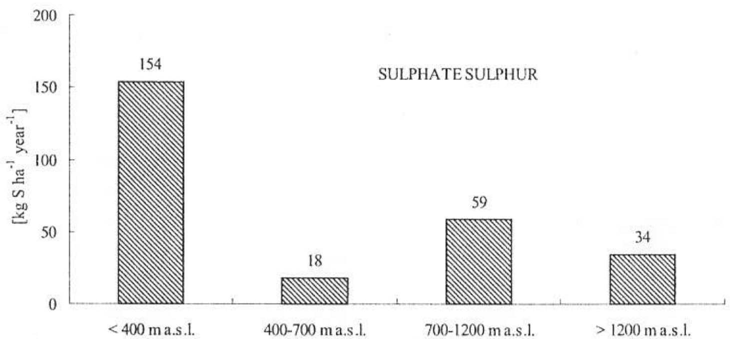

Fig. 2. Input of sulphur (sulphate) in kg ha^{-1} year^{-1} in throughfall (ST) observed in the individual zones of altitude.

The lowest mean pH value in the open area (OA) from the individual zones of altitude was determined in the zone covering 700–1200 m a.s.l. This pH value was 4.8 and it indicated the range of considerably acidity.

As for the acid components deposition, the first zone, below 400 m a.s.l. is an exception. Here we deal with Slovak lowlands and hillands with enormous input of nitrogen, both in the nitrate and ammonium forms ($N\text{-}NO_3^- + N\text{-}NH_4^+$), and of sulphate sulphur ($S\text{-}SO_4^{2-}$). The cause of this fact is to be sought in the intense fertilisation of agricultural soils and dense motorway nets with heavy traffic resulting in a high production of nitrogen oxides. Neglecting this zone we can conclude that, as it is given in Table 1, the acid constituents of acid deposition reached their maxims in the zone between 700–1200 m a.s.l., both in the throughfall and on the open area.

The deposition of sulphate sulphur ($S\text{-}SO_4^{2-}$) in this zone (700–1200 m a.s.l.) had values 33 kg in open area (OA) and 59 kg ha^{-1} year^{-1} (Fig. 2) in the throughfall (ST), nitrate nitrogen ($N\text{-}NO_3^-$) values were 10 kg and 13 kg ha^{-1} year^{-1}, respectively. The corresponding values of ammonium nitrogen ($N\text{-}NH_4^+$) were 20 kg for OA and 16 kg ha^{-1} year^{-1} for the stand (ST) (Bublinec, Dubová, 1997). So the sum of both forms (nitrate and ammonium) of nitrogen was the same for open area and for forest stand - about 30 kg N ha^{-1} year^{-1} (Fig. 3).

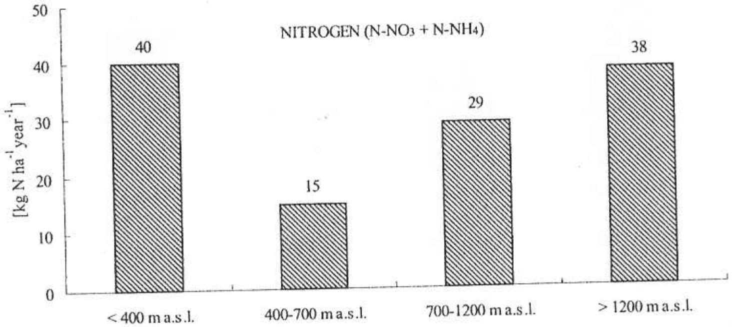

Fig. 3. Input of nitrogen (both nitrate and ammonium) in kg ha^{-1} year^{-1} in throughfall (ST) observed in the individual zones of altitude.

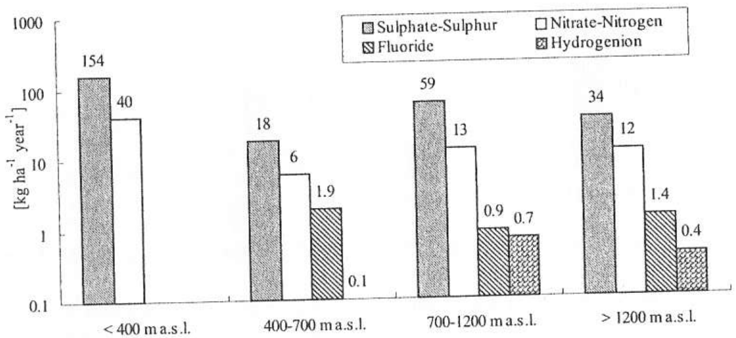

Fig. 4. Acid components of deposition in throughfall (ST) in the individual zones of altitude (kg ha^{-1} year^{-1}).

From the other acid components documented in Table 1 we point out the interesting deposition of fluoride (F^-). In all the zones of altitude we observed retention of this component in the forest stands. The maximum values of fluoride deposition were 2.5 kg (OA), and 1.9 kg ha^{-1} year^{-1} (ST) also obtained from 700 to 1200 m a.s.l.

In this zone (700–1200 m a.s.l.) the hydrogen ion (H^+) deposition in the throughfall also reached the maximum 0.7 kg H^+ ha^{-1} year^{-1}. In spite of the fact that the value determined in open area was fairly low 0.1 kg H^+ ha^{-1} year^{-1}, the amount in the throughfall causes that the hydrogen ion is a very important component of the acid deposition.

Figure 4 illustrates the acid components in the bulk deposition observed under tree crowns in forest stands in the individual zones of altitude.

The evaluation of the acid deposition in the individual zones of altitude has resulted in the fact that the values of acid input determined at the upper forest line (altitudes above 1200–1300 m a.s.l.) was in general higher than (or the same as) the corresponding values determined in the zone 400–700 m a.s.l. We suppose that it is due to the strong impact of transboundary transport of air pollutants from western and north-western Europe into the mountain forests in Slovakia, promoted by the accumulation of pollutants at the central part of the continent.

We have not observed any remarkable difference between the nitrogen input (Fig. 3) determined in the zone under 400 m a.s.l. and on the upper tree line at 1200–1300 m a.s.l. (40 a 38 kg N ha^{-1} year^{-1}, respectively). It is very important knowledge. On the contrary, in the recent years, the values of nitrogen input on the upper forest boundary (over 1200 m a.s.l.) were even higher that the input of sulphur (34 kg S ha^{-1} year^{-1}). This is evidently caused by the decreased sulphur dioxide and commonly stabilised production of nitrogen oxides in Europe. During the last years, the values of nitrogen oxide input in West Europe exceeded by two million tons the amounts of sulphur dioxide input (Mylona, 1998). Such high nitrogen amount, being accumulated within spring and summer periods causes a remarkable decline in forest ecosystem stability.

Conclusions

The chemistry of surface water is under strong influence of bulk deposition and is, consequently, very variable, site- and time-dependent (Dubová, 2000a, 2000b). It reflects the input of acid pollutants – sulphate, nitrate, fluoride (originating in fossil fuel combustion), hydrogen ion and basic components entering the ecosystem from the geological parent rock (primarily calcium). The basic constituents can, due to their buffering capacity, mitigate the impacts of acid constituents. However, the permanently increasing input of nitrogen (primarily nitrate) in higher situated areas, representing headstream areas of our rivers, can be potentially dangerous for the quality of water sources in Slovakia.

Translated by D. Kúdelová

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Dubová M., Bublinec E.: **Chemizmus zrážok a jeho vplyv na vodné zdroje.**

Vo vyšších nadmorských výškach horských lesov Slovenska (pramenné oblasti) dochádza k silnej záťaži kyslou depozíciou. Potenciálne to môže znamenať nebezpečenstvo zhoršovania kvality vodných zdrojov. Výsledky o chemizme zrážok z našej databázy sme zovšeobecnili a usporiadali podľa vegetačných a výškových pásiem: pásmo dubín (pod 400 m), bučín (400–700 m), smrečín (700–1200 m) a hornej hranice lesa (nad 1200 m). Najkyslejšie zrážky sú v pásme 700–1200 m, pH je 4,8 (VP – voľné priestranstvá) a 4,0 (porasty). Depozícia kyslých zložiek v pásme do 400 m (oblasť nížin a pahorkatín) predstavuje výnimku. Vstupy dusíka aj síry sú enormne vysoké (poľnohospodárstvo, hnojenie pôd, intenzívna autodoprava). Vypustením tohto pásma, kyslé zložky depozície dosahujú maximálne hodnoty v zóne 700–1200 m, na VP aj pod korunami v lesných porastoch: síranová síra 33 a 59 kg (VP a porasty), dusičnanový dusík 10 a 13 kg, dusičnanový a amoniakálny dusík ca 30 kg N, fluoridy 2,5 a 1,9 kg, hydrogénové ióny 0,1 a 0,7 kg ha^{-1} rok^{-1}. Vstupy kyslých zložiek nad 1200 m sú spravidla vždy väčšie (alebo aspoň rovnaké), ako v zóne 400–700 m. Vstupy dusíka v porastoch pod 400 m a nad 1200 m sú prakticky rovnaké (40 a 38 kg N ha^{-1} rok^{-1}), v oblasti hornej hranice lesa dokonca väčšie ako síry (34 kg S ha^{-1} rok^{-1}).

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