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SULPHUR CONTENT IN DANDELION (*Taraxacum officinale*) AS AN INDICATOR OF THREAT TO AGROECOSYSTEMS

H. Terelak, T. Motowicka-Terelak

Department of Soil Science and Land Conservation, Institute of Soil Science and Plant Cultivation, Czartoryskich 8, 24-100 Puławy, Poland

A b s t r a c t. Dandelion (*Taraxacum officinale*) was used in a KBN-supported project focused on the assessment of the extent to which Polish agricultural environment is contaminated with sulphur. Studies were carried out in different regions of the country. Sulphur content in leaves of that plant at full blooming varied with the level of sulphur contamination of soil and air. Dandelions from the heavily industrialised areas of the Upper Silesia, Legnica-Głogów Copper Mining District, and the Tarnobrzeg Sulphur Mining District showed high sulphur content and the S content (0.4%) in excess of the threshold value for this species.

K e y w o r d s: sulphur content, dandelion, soil.

INTRODUCTION

Sulphur is an essential element for all living organisms. Volcanic activity provided the primary source of that nutrient from volcanoes. Sulphur made its way to atmosphere and to the soil where it is taken up by plants [8,9]. The natural biogeochemical turnover of sulphur was seriously disturbed by man in the second half of the 20^{th} century. Development of the industrial civilisation and particularly, of power industry, automobiles and urbanisation resulted in a dramatic rise of SO_2 emission (Fig. 1) which contributed to biosphere and agricultural environment contamination with sulphur compounds [4,10]. This speeded up acidification of soils and triggered the process of their chemical degradation [7,8].

The threat to agricultural productive space posed by an excessive sulphur emission from the sulphur-contaminated atmosphere is estimated by the threshold values of S content for the soil and plants [5]. Due to direct SO_2 penetration through stomata, plants also provide a good indication of air contamination with sulphur. Dandelion (*Taraxacum officinale*) is often used for bio-geochemical surveys [2,3]. This

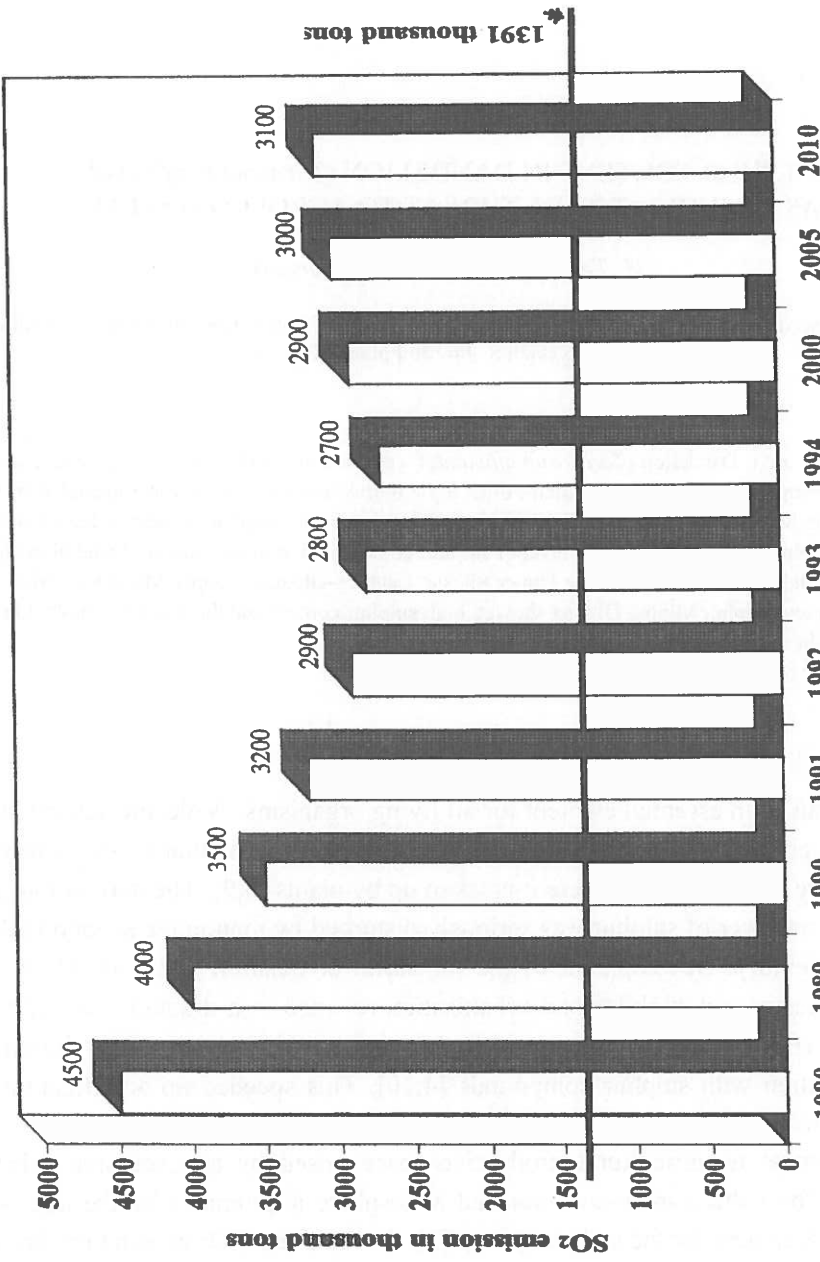

Fig. 1. SO_2 emission in the years 1980-1994 and emission prediction up to 2010* as compared to the amount of emission to be reached to the 2nd Sulphur Protocol [5].

plant is remarkable for its high coefficient of relative pollutant accumulation and has long been used as a plant indicator in environmental research.

METHODS

Study on the suitability of danelion as indicator plant to assess contamination of agricultural environment with sulphur was conducted as part of the KBN-funded project entitled: "Heavy metals and sulphur in an indicator plant and in the soils as the basis for the national spatial land management strategy". To implement the project, 870 sites arranged in a geographic network, were singled out across Poland. The approximate density was one site per one square of 25 x 25 km. Between the 10 and 20th of May, the period of dandelion full blooming in various regions, soil samples were collected from the humus layer (3 to 15 cm deep) and from the dandelion plants. Upon delivery to the soil chemistry laboratory at the IUNG, Puławy, the samples were subjected to a special preparatory protocol for trace chemical analysis [3]. Total S content of the soil and plant material was determined upon dry ashing using the nephelometric method [1].

RESULTS AND DISCUSSION

Data listed in Table 1 show that in the beginning of the 90-ties sulphur content in the Polish soil varied to a far higher extent than quoted in the earlier studies [8,9].

It is proved by the maximum values which, in some textural groups represented, an increase of 100 to 400 mg S/100 g on the values reported to-date (6-120 mg S/100 g). The mean values also point to an increase in the sulphur content of mineral soils since they range from 25.1 to 44.8 mg S/100 g. The corresponding range reported for the 1970-ties was from 15 to 25 mg S/100 g [9]. The comparison of data provides clear evidence that over the last 20 years Polish soils have been significantly enriched with sulphur. The underlying cause for such an increase was

Table 1. Statistics of sulphur content (mg/100 g) in textural soil groups

Soil textural group (n)	Range	Means		Median
		A	G	
Light soils (579)	6-160	28.8	25.1	25.0
Medium-heavy soils (168)	10-212	31.2	27.9	28.8
Heavy soils (103)	10-580	44.8	36.5	36.0
Organic soils (26)	52-670	185.4	143.4	129.4

n - number of samples; A - arithmetic mean; G - gemetric mean.

SO_2 emission which up to the 1990-ties was high and continued to rise with time according to unofficial data (Fig. 1). Its impact on the agricultural environment is not merely confined to the industrialised areas but is known to be of a far-reaching nature [7].

A diagram representation of the sulphur content in dandelion leaves (Fig. 2) shows that plants with elevated sulphur contents, as measured against the natural background, could be found locally throughout the country. However, sulphur build-up in dandelion leaves was similar and either did not exceed or exceeded but slightly the natural content threshold established as 0.4% S on the air-dry basis [5]. In the southern region, especially the western, central, and eastern parts, there were areas in which dandelion showed a remarkable high sulphur content. The highest in sulphur were dandelion leaves from the heavily industrialised areas i.e. the Upper Silesia industrial area, Legnica-Głogów Copper Mining District, Tarnobrzeg Sulphur Mining District, and from other areas exposed to major sulphur emission sources. In those areas the highest percentage of sulphur-contaminated soils were found (Table 2).

Table 2. $S\text{-}SO_4$ contents of Poland's soils

Voivodeship (province)	Percentage of soils according to $S\text{-}SO_4$ content range			
	low	medium	high	very high
Częstohowa	30	34	28	8
Katowice	20	31	36	13
Kraków	24	37	31	8
Opole	34	35	21	10
Zielona Góra	37	34	28	5
Poland	54	26	15	5

To sum up, variation in sulphur content of dandelion leaves across the country could be related to the degree of sulphur contamination in air and soil in Poland.

CONCLUSIONS

1. The study showed that dandelion can be used as an indicator of sulphur contamination of the agricultural environment.

2. Sulphur content of dandelion leaves shows that in some regions of Poland there is a real hazard of excessive sulphur emission.

3. On the basis of the available data, heavily industrialised regions in southern Poland should be rated having the highest risk of excessive S emission.

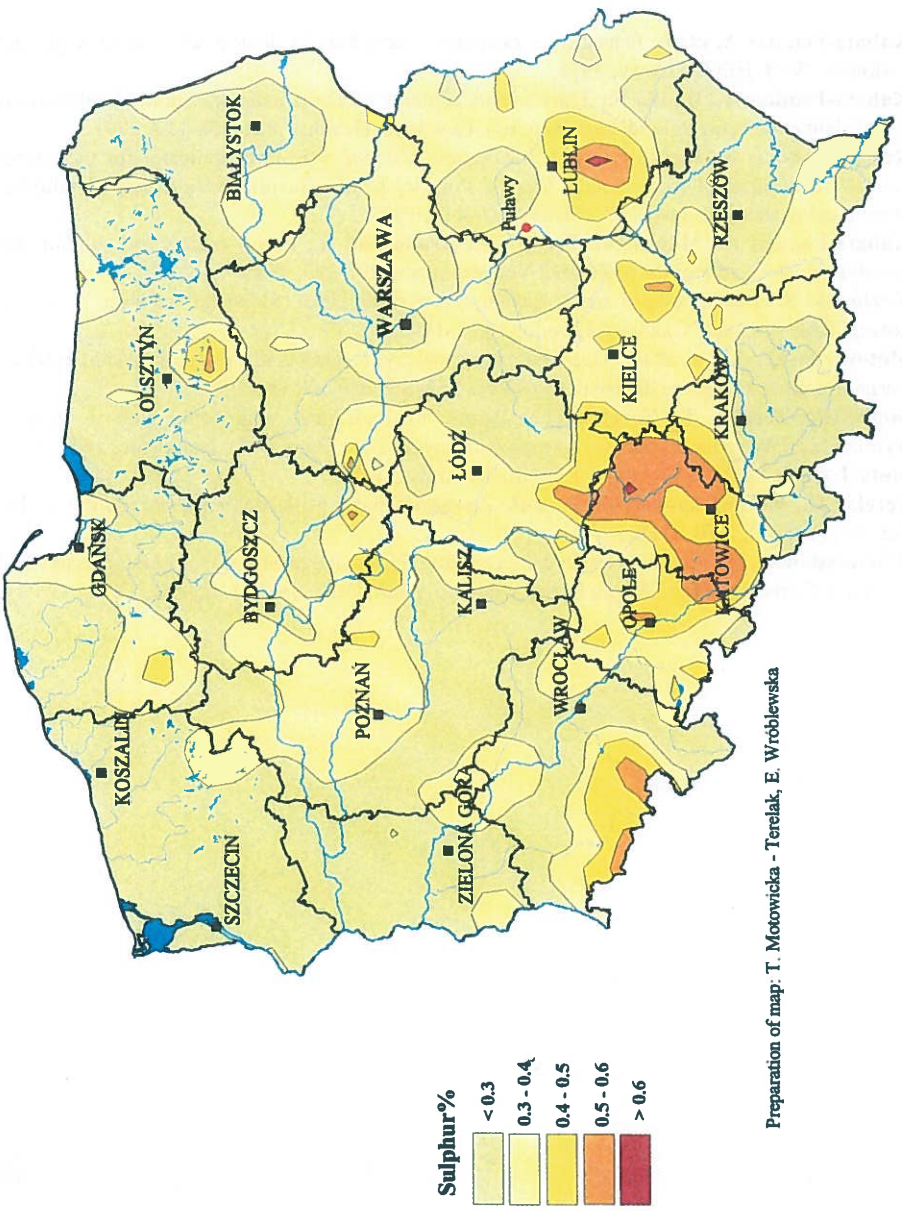

Fig. 2. Sulphur content of dandelion leaves across Poland.

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