State and Perspective of Sulphur Fertilisation in Poland

Franciszek WIELEBSKI and Marek WOJTOWICZ

Plant Breeding and Acclimatization Institute ul. Strzeszynska 36, 60-479 Poznan (Poland)

INTRODUCTION

Winter rape like other cruciferous plants requires large amount of sulphur (Johansson 1962, Horodyski i in. 1972). Sulphur demand of oilseed rape is about 1,5-2 kg/ dt of seeds. However there is a strong discrepancy between natural supply and requirement.

In the past the inputs of sulphur from the atmosphere was high so volatile sulphur compounds were the most important source of this nutrient for plants. Sulphur nutrition was ignored because the input from the atmosphere was sufficient for most crops.

At the beginning of the 80s emission of sulphur dioxide (SO_2) decreased as a result of the West European Country policy on pollution control. Low input of sulphur from the atmosphere caused deficiency of this nutrient in plants (Merrien 1987. Schnug i in. 1995). At present sulphur deficiency symptoms can be observed in many plant species. The serious symptoms there are on plants with high demand for this nutrient. A deficiency of sulphur causes yellowing of younger leaves (Horodyski i in. 1972). With a severe deficiency the leaves tend to be poorly developed and cupped and have purple colour on the backs.

EMISSION OF SULPHUR

In Poland emission of sulphur has been getting lover since 1990, but it is still to high. In 1991, according to OECD, Poland was placed third in Europe in sulphur dioxide (SO_2) emission. In the 80s emission of sulphur amounts 70 kg S/ha. In 1990 it was diminished to 51 kg S/ha and in 1995 amounted only 42 kg S/ha (Fig. 1). It is still over twice higher than in Western Countries such as England, France, Germany and Scandinavian Countries. Reduction of sulphur emission was caused by economical recession after 1989 and by the government policy on pollution control. There is large difference in sulphur emission between different regions of Poland (Fig. 2). The highest emission is noticed in industry areas. For instance in Silesia emission amounts 300 kg S/ha/yr. In agriculture area, far away from industry, sulphur emission is low and amounts about 10 kg/ ha/yr. Low input of sulphur from the atmosphere, the use of fertilisers which don't contain sulphur and removal of this nutrient by crops, will cause necessity of sulphur application in the near future.

Many soils in Poland especially light textured and medium textured with poor absorbing complex are deficient in available sulphur (below 1mg/100g of soil = 30 kg S/ha) (Terelak i in. 1988). Easy leaching of this nutrient from the soil, low level of organic matter and low level of organic fertilisation, large participation of crops with high sulphur requirements cause the necessity of sulphur fertilisation in some region of Poland now.

Fig. 1

Sulphur emission in Poland (Source - Year Book)

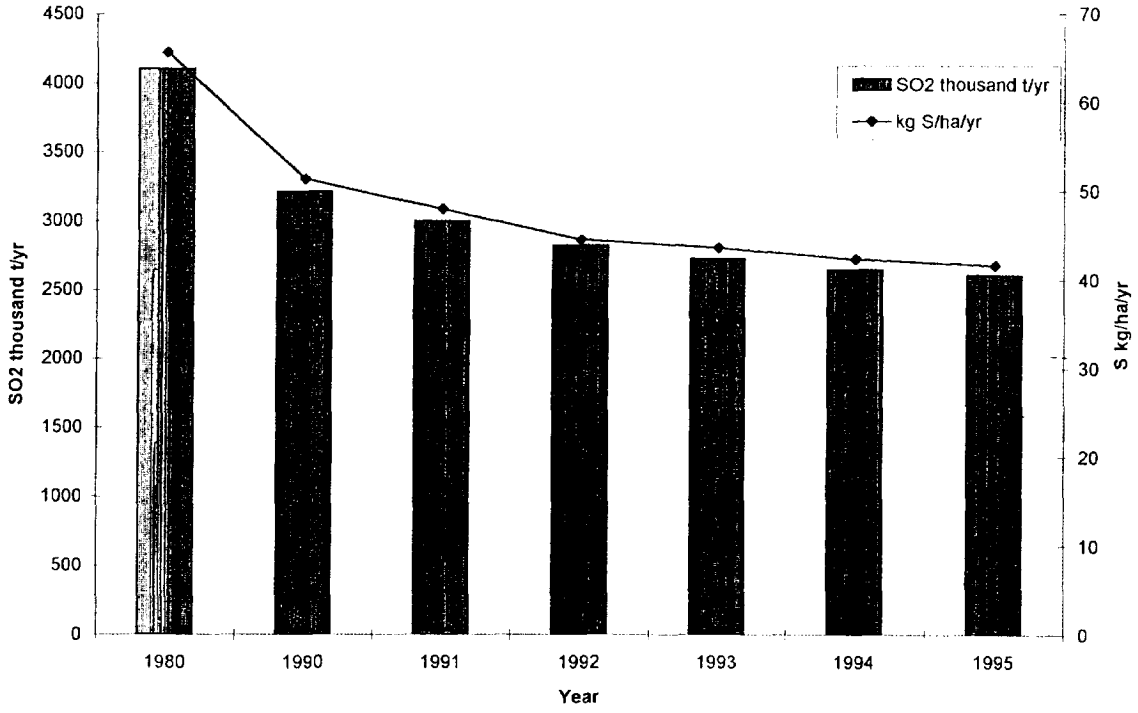
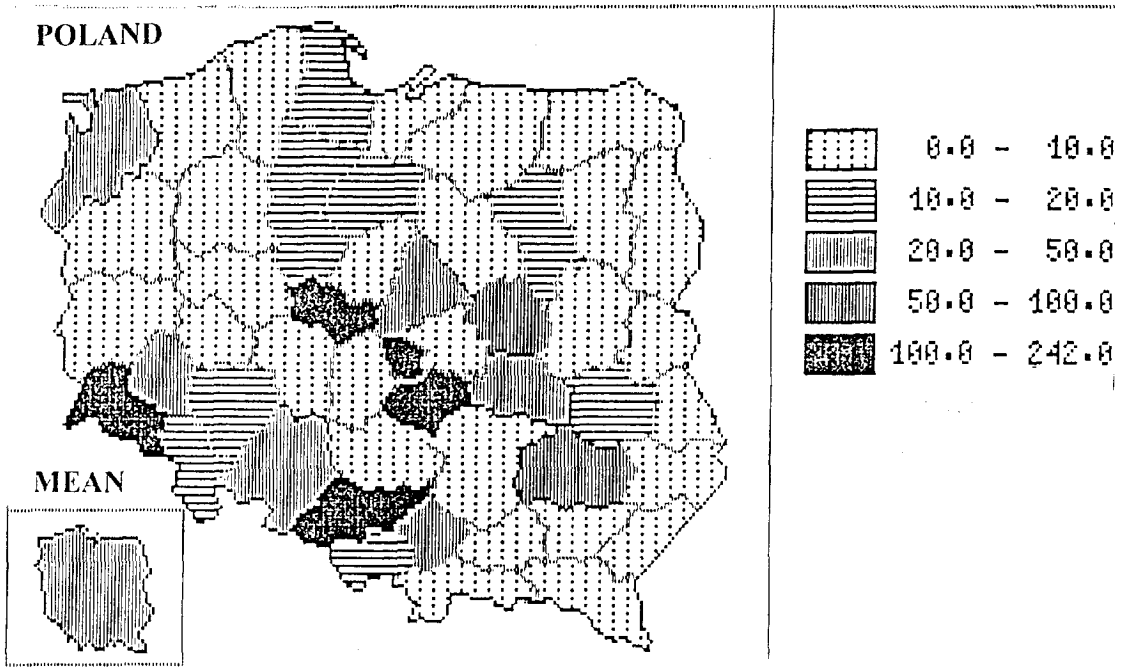


Fig. 2

Sulphur emission (S kg/ha/yr) in particular provinces of Poland in 1995 year (Source - Year Book)



EXPERIMENTAL RESULTS

Research studies carried out in 1995 by Agricultural Chemistry Department of University of Agriculture and Institute of Soil Science and Plant Cultivation gave some up-to-date information about latent deficiency symptoms in rape grown in North-West part of Poland (Grzebisz 1996).

In trials conducted in 1991-93, by Plant Breeding and Acclimatization Institute and Oil Crop Department of Agriculture University in Poznań sulphur deficiency in light textured soil in Zielęcin and heavy textured soil in Przybroda was not found. That was proved by high content of sulphur in younger leaves on control objects (table 1). In good sulphur supply conditions, fertilisation with reasonable doses (20 i 40 kg S/ha) doesn't have an influence on seed yield of Bolko and Ceres - cultivars of winter rape. High dose of sulphur (80 kg S/ha) caused small decreasing of seed yield (table 1). The applied doses of sulphur increased glucosinolate content by 10-15%.

Tab. 1

Influence of sulphur doses on sulphur content in leaves, seed yield and alkenyl glucosinolate content in seeds of tested double low winter swede rapes cultivars (Fields trials, Przybroda and Zielęcin, 1991-1993)

Dose of sulphur kg/ha	Sulphur content in leaves in flowering stage (per cent)		Seed yield dt /ha		Alkenyl glucosinolate content μM/g d.f.d.m.*	
	Bolko	Ceres	Bolko	Ceres	Bolko	Ceres
0	0,71	0,80	39,4	42,8	10,8	16,4
20	0,89	0,88	39,1	42,7	11,5	18,3
40	0,94	0,96	40,1	42,6	11,8	18,6
80	1,09	1,07	39,0	41,3	12,1	18,9
NIR	0,33	0,34	0,31		0,71	
Mean for cultivar	0,93	0,94	39,4	42,5	11,3	17,5
NIR	n.s.		0,18		0,19	

* d.f.d.m. - defatted dry matter

Small (5%) but significant increase in the seed yield was observed when doses of 20 and 40 kg of sulphur had been applied in the budding stage in field experiments carried out in 1990-93 in the non-industrial region of Poland (Budzyński and Ojczyk 1995). Negative influence of sulphur on glucosinolate content was clearly observed. It caused increase in glucosinolate content by 5-10%.

Increasing doses of sulphur in pot trials demonstrated a significant influence on the seed yield. In field and pot trials the level of sulphur supply affects the glucosinolate content in seeds. Increase of glucosinolate content was higher in Ceres

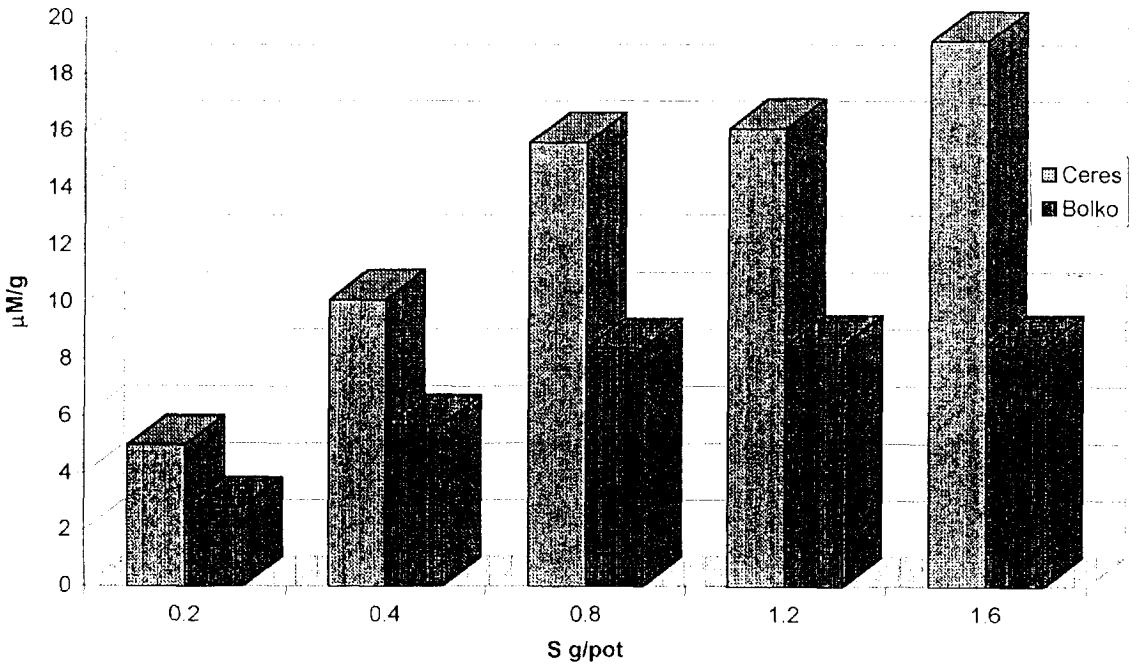
cultivar which has a higher level of these anti-nutritive substances in seeds than in Bolko cultivar (table 1, fig. 3). Pot experiment showed that large doses of sulphur caused higher increase of alkenyl glucosinolate content in Ceres cultivar than in Bolko. Bolko cultivar by doses higher than 0,8g S/pot did not change the glucosinolate level. Research study carried out by CETIOM (1989) shoved also that sulphur fertilisation causes slower increase of glucosinolate content in cultivars with very low glucosinolate content than in cultivars with higher level of this compounds. Quality of the glucosinolate depends on the sulphur fertilisation. Increasing sulphur application increased content of alkenyl and decreased the level of indol glucosinolate (fig. 4).

CONCLUSION

Decrease of sulphur inputs from the atmosphere gained importance of fertilisation by this nutrient in Polish farming. Sulphur deficiency limits rapeseed production, so sulphur has to be taken into consideration in fertilisation plans. However adding a heavy rate of sulphur is not recommended because it can lower the quality of seeds. In this circumstances, decision of sulphur fertilisation should be made after soil and plants tests.

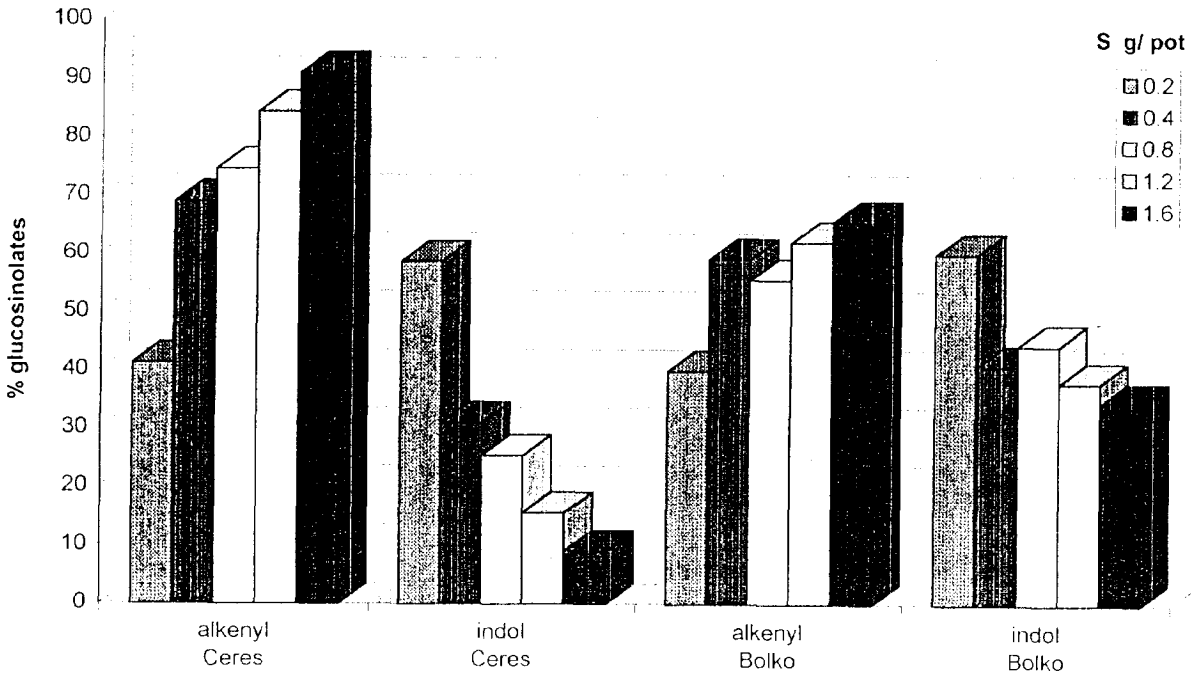
Fig. 3

Effect of cultivar and level of sulphur rate on alkenyl glucosinolate content (μM/g), (Pot trial 1992-1994)



Rys. 4

Composition (%) of alkenyl and indol glucosinolates according to the cultivar and sulphur fertilisation (Pot trial)



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