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EFFECT OF SULPHUR FERTILISATION ON YIELD AND QUALITY OF WHITE MUSTARD SEEDS

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Abstract

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The objective of the present study was to estimate the effect of different forms of sulphur on yields and qualitative parameters of white mustard seeds. This topic was studied in 2004 in the form of a pot trial in a vegetation hall and linked up with an identical experiment with spring wheat conducted in 2003. Besides the control variant not fertilised with sulphur (1) we fertilised the soil with elemental sulphur (2), ammonium sulphate (3) and gypsum (4) and applied foliar dressing of elemental sulphur with bentonite (5). For all variants the nitrogen dose was 0.9 g per pot (0.15 g.kg^{-1} of soil) and for variants 2 to 4 it was 1 g of sulphur per pot (0.17 g. kg^{-1} of soil). Foliar dressing of elemental sulphur (S^0) was not applied until the stage of six true leaves in a dose of 10 kg per ha (0.032 g per pot).

Significantly higher yields of white mustard seeds were achieved after foliar application of S^0 which can be also due to its fungicide action. The variants where gypsum was applied showed the highest average number of branches and pods and also straw yields. After gypsum fertilisation or foliar application of S^0 the oil content in the mustard seeds exceeded 25%; this is the minimal content required for the production of good quality mustard. The 1000-seed weight was significantly higher after foliar application of S^0. The proportion of seeds greyish on the surface, a sign of mildew, significantly decreased after fertilisation with all forms of sulphur, but most of all after foliar application of S^0.

Fertilisation with ammonium sulphate reduced the exchangeable soil reaction after harvest. On the other hand gypsum alkalised the soil environment and increased the content of available calcium and water-soluble sulphur. The soil of the variant where foliar dressing of S^0 was applied had a higher content of available calcium after harvest. The least amount of available sulphur and phosphorus in the soil was seen after foliar application of S^0 signalising a more efficient uptake of nutrients from the soil for the production of seed yields and for the quality of the seeds.

white mustard, elemental sulphur, ammonium sulphate, gypsum, yields, quality

In the past most of the demands of agricultural crops for sulphur had been covered by atmospheric depositions. However, in the experimental year 2004 these depositions in the Czech Republic were reduced to 12.1% of the situation in 1990; in 2004 it was only 8.8 kg of S per ha (Hůnová et al., 2005). This rapid drop was the main reason why the use of sulphur-containing fertilisers has increased so much.

On a worldwide scale and also in the Czech Republic the most frequently used fertiliser containing sulphur is ammonium sulphate with a 24% content of S (Ceccotti et al., 1998). An important source of sulphur in the Czech Republic used to be single superphosphate, which contained 8–12% of S, and which has now virtually disappeared from the market. Due to its high price also the once used potassium sulphate (18% of S) is now applied only to a limited extent. On the other hand we see the comeback of gypsum (12–18% of S), which had been recommended as early as the 19th century (Duchoň, 1948).

Side by side with conventional mineral fertilisers containing sulphate ions also S^0 – elemental sulphur (80–99%) is gaining ground. It is an ideal slow-action fertiliser and is not water-soluble; before uptake and utilisation in the plant it has to be oxidised to water-soluble sulphate (Blair, 2002). During foliar application it is also oxidised by bacteria of the genus *Thiobacillus* on the leaf surface or inside the leaf by specific enzymes of chloroplasts (Jolivet, 1993). The condition for its wider use as a fertiliser is based on the reduction of the limit content of sulphur in fuel (binding EU rule of law) from 350 mg.kg^{-1} to 50 mg.kg^{-1} in 2005, and/or 10 mg.kg^{-1} in 2008.

Among plants with high demands for sulphur the most important are plants of the family *Brassicaceae*. In addition to increased acreage of winter rape the acreage of white mustard is gradually increasing too; the Czech Republic is the most important producer and exporter of this crop (Mikšík et al., 2007).

The objective of the present study was to estimate the effect of S^0, ammonium sulphate, gypsum and foliar application of S^0 on yields and qualitative parameters of white mustard seeds.

MATERIAL AND METHODS

Sulphur fertilisation and its effect on yields and qualitative parameters of white mustard seeds was explored in 2004 in the vegetation hall of Mendel University of Agriculture and Forestry in Brno. The locality Brno-Černá Pole lies in an altitude of 239 m, latitude 49° 13’ 01”, longitude 16° 36’50”: the average annual temperature is + 8.4°C, average annual precipitation 531 mm and average sunshine 1860 h.year^{-1}. It is a warm region, climate region A3 (warm, moderately dry, with mild winters).

Investigations were carried out in the form of a vegetation pot trial and linked up with an identical trial with spring wheat conducted in 2003 (Ryant et Hřivna, 2004). The substrate in Mitscherlich’s pots (6 kg of mixture of soil from the School Farm in Žabčice – medium heavy gley Fluvizem and Bratčice sand at a 2:1 ratio) was left over after growing spring wheat. The mixture contains an average content of C_{ox} 2.7 %, total nitrogen 0.13 % of dry matter, and total sulphur 214 mg.kg^{-1} of dry matter.

Tab. I gives a detailed survey of the exchangeable soil reaction and content of available nutrients in the substrate of the variants before sowing white mustard.

I: *Exchangeable soil reaction and content of available nutrients in the substrate*

var.	pattern	$pH/CaCl_2$	mg.kg^{-1}				
			P	K	Ca	Mg	$S_{water\text{-}solub.}$
1	Control (C)	7.30	85.8	138.7	2742	213.4	56.10
2	Elemental sulphur (ES)	7.32	83.8	114.9	2518	200.1	115.00
3	Ammonium sulphate (AS)	7.36	82.7	130.8	2524	211.4	75.60
4	Gypsum (GS)	7.47	80.8	106.3	2478	187.7	59.90
5	Foliar elemental sulphur (FES)	7.23	78.9	133.7	2955	259.7	37.00

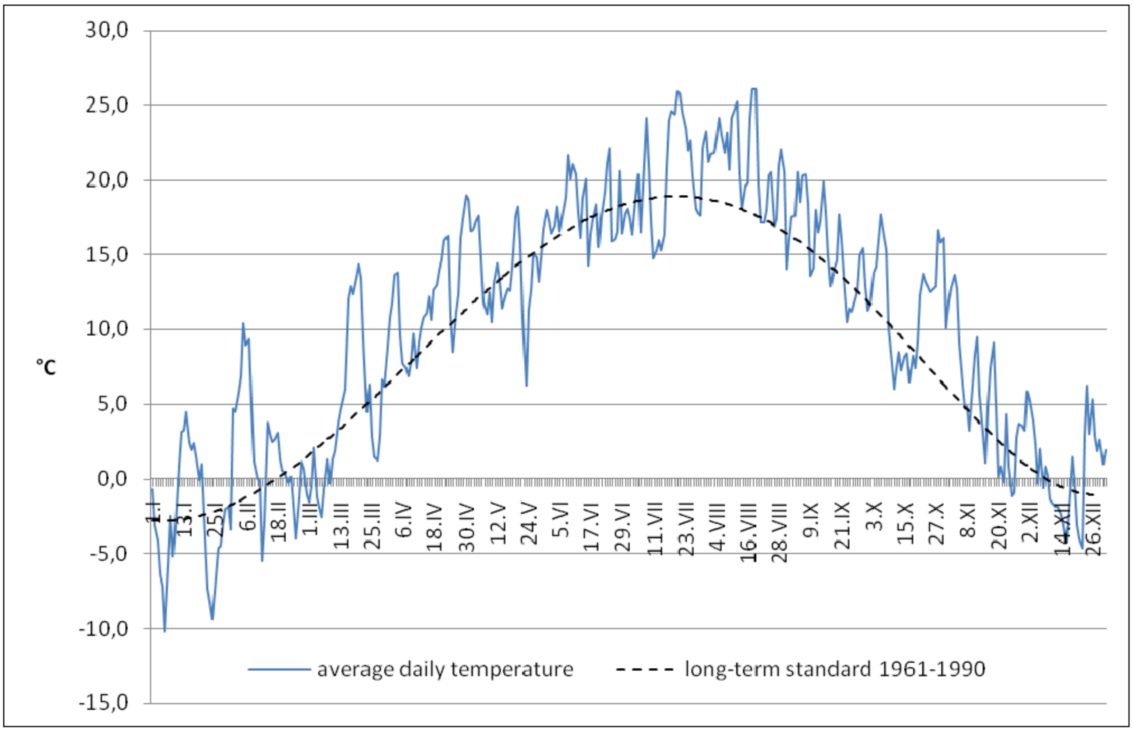
The exchangeable soil reaction was assessed in a 0.01 M $CaCl_2$ extract, the content of P, K, Ca and Mg using the method of Mehlich III and the content of available sulphur in an extract with water at a 1:5 ratio (Zbíral, 2002). Pursuant to the Regulation of the Czech Ministry of Agriculture No. 275/1998 Coll., the soil showed an alkali, or neutral, soil reaction in variant 5. The supply of available phosphorus was at a good or satisfactory (var. 5) level; the content of potassium was good or satisfactory, the content of calcium and magnesium was good and the content of water-soluble sulphur differed among the variants due to the previous year of investigations. According to Mikšík et al. (2007) the soil where white mustard is grown should contain at least 60 mg of phosphorus, 200 mg of potassium, 60 mg of magnesium and the content of available sulphur should be more than 20 mg per 1 kg.

Tab. I shows the individual forms of sulphur used in the trial. Each variant was established with 4 replications. First fertilisation was conducted on 16 April 2004; the fertilisers were incorporated in the soil ca 1 cm under the surface. The nitrogen dose per pot was 0.9 g (0.15 g.kg^{-1}). In the form of ammonium sulphate 1 g of sulphur per pot was supplied (0.17 g.kg^{-1}); the same dose of sulphur was also applied in S^0 and gypsum.

Elemental sulphur (S^0) was applied in the form of a fine yellow powder substance (sublimed sulphur) which contained 99.8 % of S. Ammonium sulphate (SA) was applied in the form of fine grey crystals and content of 21 % N and 24 % S. Gypsum was applied in the Pregips H fertiliser (14 % S and 25 % CaO); in chemical terms it is calcium sulphate supplied in the form of a fine grey powder. Its saturated solution contained 2.6 g $CaSO_4.2H_2O$ per litre of water. S^0 (variant 5) was applied as top dressing with the then registered fertiliser Orin basis S. It is a dispersive micro-granulate of S^0 and bentonite forming a suspension and containing 80 % of elemental sulphur. Foliar application of micronised S^0 was performed on 19 May at a dose of 10 kg per ha (0.032 g per pot).

On 16 April, immediately after the first fertilising the white mustard, variety Zlata, was sown out, always several seeds into 4 places in the pot. At the stage of 6 true leaves (17 May) the pots were thinned to 4 plants per pot and at the beginning of flowering the number of plants was reduced to 3 per pot.

The experimental pots were kept free of weeds; sufficient moisture of the substrate was provided by regular watering to ca 60 % of the maximal water capacity. Of all weather conditions the period of white mustard vegetation was affected particularly by the temperature as can be seen in Fig. 1.



1: *Course of average daily temperatures in 2004 (Brno-Černá Pole)*

On 19 May and 1 June the stand was treated with the insecticide KARATE 2,5 WG, primarily against flea beetles.

The plants were harvested on 2 August in the stage of full maturity by cutting the branches. At harvest we counted the number of branches, number of pods and after threshing the pods also the yields of seeds and straw were recorded, the 1000-seed weight (TSW) and the proportion of grey seeds. Consequently the oil content of the seeds was determined. After harvest (August 3, 2004) the exchangeable soil reaction and content of available nutrients, namely sulphur, was determined in the used soil and sand mixture. The yields and qualitative parameters of the seeds were evaluated using the multifactor analysis of variance and subsequent tests were performed using Tuckey's test of significance of differences by means of the Statistica version 8.0 software.

RESULTS AND DISCUSSION

In a pot experiment we applied two forms of sulphate sulphur and two forms of elemental sulphur (S^0) and a control variant not fertilised with sulphur. Tab. II shows the significance of the effects of various variants of fertilisation on the yield parameters; Tab. III shows the qualitative parameters of the seeds. In terms of yields the effect of the fertilisation variant was significant ($P > 0.95$) only in seed yields. The effect on all the qualitative parameters was highly significant ($P > 0.999$).

No significant differences were discovered in the numbers of branches and pods per pot; they ranged from 18 to 21 and from 448 to 521, respectively. Even so of all the sulphur-fertilised variants the gypsum-fertilised variants had the highest number of branches and pods per pot (Tab. IV and Fig. 2) as well as the highest average straw yields which ranged from 32.76 to 36.62 g per pot, although this was insignificant due to a higher variability (Tab. IV and Fig. 3). Seed yields of sulphur-fertilised variants were higher, but only the foliar-applied S^0 variant showed a statistically significant increase (Tab. IV and Fig. 3).

For instance Schnug et al. (1998) described the positive effect of foliar application of S^0; they compared the foliar application of sulphate and elemental sulphur. A particular advantage of a foliar application of S^0 from the nutritional point of view is its continuous, slow oxidation to sulphate, followed by a continuous uptake of sulphate and utilisation in plants. In numerous field experiments the use of S^0 yielded better results than a sulphate fertiliser (Klikocka et al., 2005). The reason was the fungicidal next to its nutritional effect.

Tab. V and Figs. 4 and 5 show the achieved qualitative parameters and significance of the differences.

The average oil content of the mustard seeds ranged between 24.2 % (controls not fertilised with sulphur) and 29.1 % (gypsum-fertilised variant). The oil content as a qualitative indicator of white mustard seed used for the production of mustard as a condiment should comply with the redemption standard which specifies (White Mustard – ČN 46 23 00-4) a 21 % oil content at 10 % moisture; all variants complied with the standard also when converted to the required moisture. Zukalová et al. (1990) stated that in compliance with the demands of processors of white mustard the minimal oil content in the seeds should be 25% to achieve at least 5% of oil in the mustard product. Only the sulphur-fertilised variants achieved or significantly exceeded this limit; the oil content of seeds was significantly higher (P > 0.95) in seeds of the gypsum-fertilised variant (29.1%) and with foliar application of S^0 (28.3 %) – see Tab. V and Fig. 4.

The second qualitative parameter was the 1000-seed weight which ranged from 5.08g in the control not fertilised with sulphur to 7.38g in the variant where top dressing of S^0 was applied. These values correspond with the average range

II: *Analysis of variance of yield parameters of white mustard*

Factor	d. f.	Average square			
		number of branches per pot	number of pods per pot	seed yields	straw yields
Variant	4	13.175 NS	3186 NS	2.952 *	9.41 NS
Error	15	12.283	4047	0.771	16.92
Total	19				

d. f. = degree of freedom; NS = not significant; * > 0.95

III: *Analysis of variance of qualitative parameters of white mustard seeds*

Factor	d. f.	Average square		
		oil content	TSW	proportion of grey seeds
Variant	4	19.34 ***	2.8442 ***	0.9382 ***
Error	15	2.21	0.1422	0.1022
Total	19			

d. f. = degree of freedom; NS = not significant; TSW = 1000-seed weight; * > 0.999

IV: *Average values of yield parameters of white mustard and the significance of their differences according to Tuckey*

Factor	Level of factor	n	number of branches per pot $\bar{x} \pm s_x$	number of pods per pot $\bar{x} \pm s_x$	seed yields (g/pot) $\bar{x} \pm s_x$	straw yields g/pot) $\bar{x} \pm s_x$
Variant	C	4	$21^{a} \pm 1$	$469^{a} \pm 51$	$8.84^{a} \pm 0.43$	$32.76^{a} \pm 2.22$
	ES	4	$18^{a} \pm 1$	$461^{a} \pm 15$	$9.87^{ab} \pm 0.47$	$33.99^{a} \pm 1.21$
	AS	4	$18^{a} \pm 2$	$448^{a} \pm 13$	$9.88^{ab} \pm 0.26$	$33.59^{a} \pm 1.79$
	GS	4	$21^{a} \pm 3$	$521^{a} \pm 34$	$9.99^{ab} \pm 0.50$	$36.62^{a} \pm 2.67$
	FES	4	$20^{a} \pm 1$	$484^{a} \pm 30$	$11.25^{b} \pm 0.49$	$35.40^{a} \pm 2.09$

Note: The average values of the individual variants do not differ significantly (P > 0.95) if an identical superscript is not attached.
n – number of observations

V: *Average values of qualitative parameters of white mustard seeds and significance of the differences according to Tuckey*

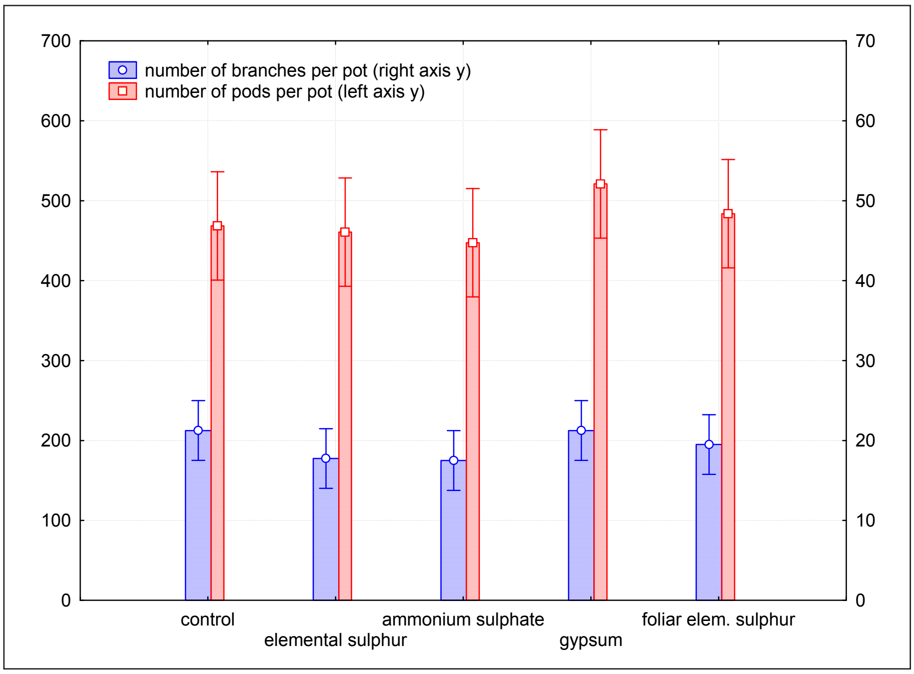
Factor	Level of factor	n	oil content (%) $\bar{x} \pm s_x$	TSW (g) $\bar{x} \pm s_x$	proportion of greyish seeds $\bar{x} \pm s_x$
Variant	C	4	$24.2^{a} \pm 0.86$	$5.08^{a} \pm 0.14$	$5.43^{b} \pm 0.18$
	ES	4	$25.0^{ab} \pm 1.10$	$6.15^{b} \pm 0.13$	$4.60^{a} \pm 0.13$
	AS	4	$28.2^{bc} \pm 0.54$	$6.23^{b} \pm 0.23$	$4.65^{a} \pm 0.19$
	GS	4	$29.1^{c} \pm 0.15$	$6.70^{bc} \pm 0.24$	$4.58^{a} \pm 0.15$
	FES	4	$28.3^{c} \pm 0.71$	$7.38^{c} \pm 0.18$	$4.08^{a} \pm 0.14$

Note: The average values of the individual variants do not differ significantly (P > 0.95) if an identical superscript is not attached.
n – number of observations; TSW = 1000-seed weight

VI: *Exchangeable soil reaction and content of available nutrients in the soil after harvest*

factor	Level of factor	n	pH/CaCl$_2$	mg.kg^{-1}				
				P	K	Ca	Mg	S
variant	C	4	7.40^{bc} ± 0.06	65.0^{b} ± 2.0	91.9^{ab} ± 2.0	2630^{a} ± 51	193.8^{a} ± 3.7	56.0^{a} ± 6.3
	ES	4	7.31^{ab} ± 0.03	65.4^{b} ± 1.6	92.7^{ab} ± 0.9	2608^{a} ± 34	207.3^{b} ± 2.2	264.3^{bc} ± 15.0
	AS	4	7.19^{a} ± 0.04	65.4^{b} ± 0.3	90.6^{a} ± 3.4	2585^{a} ± 18	209.0^{b} ± 1.2	328.5^{cd} ± 5.8
	GS	4	7.48^{c} ± 0.03	63.7^{b} ± 0.9	87.7^{a} ± 0.8	2750^{a} ± 46	186.8^{a} ± 4.9	358.8^{d} ± 29.1
	FES	4	7.44^{bc} ± 0.03	57.4^{a} ± 1.2	101.9^{b} ± 3.4	3123^{b} ± 38	272.0^{c} ± 1.7	42.0^{a} ± 4.4

Note: The average values of the individual variants do not differ significantly ($P > 0.95$) if an identical superscript is not attached.
n – number of observations

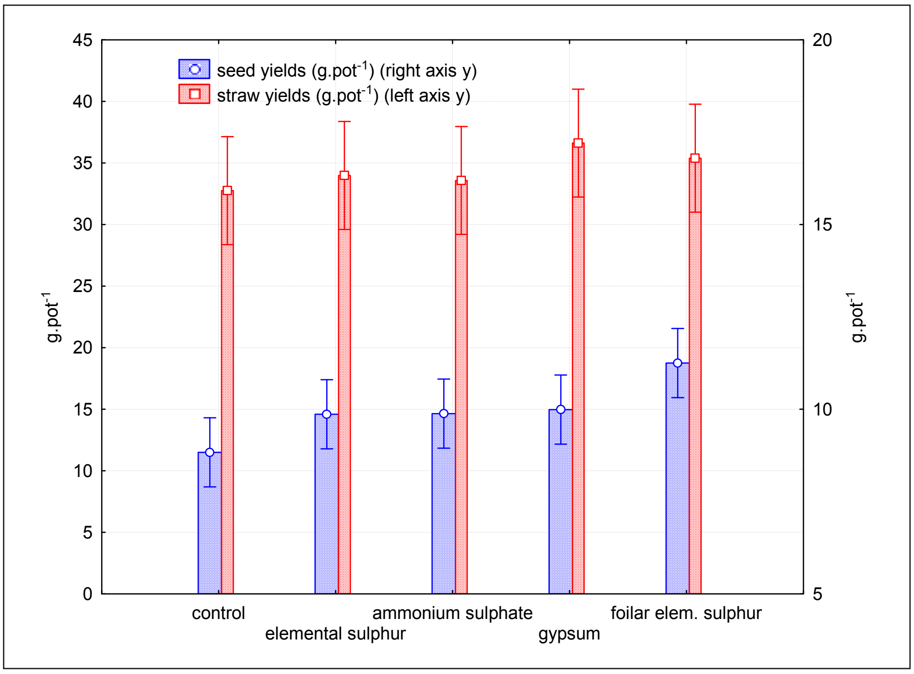


2: *Number of branches and number of pods of white mustard*

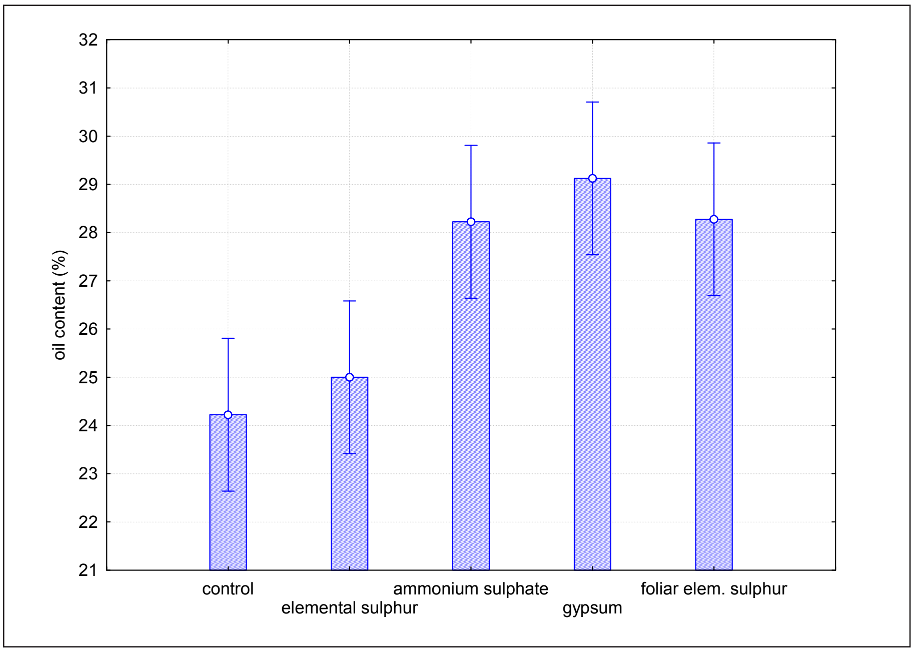
given in literature (Seiffert et Makowski, 1988; Fábry, 1963; Zukalová et al., 1990; Mikšík et al., 2007). Like the seed yields also the average 1000-seed weight was higher in variants with sulphur; however a statistically significant increase ($P > 0.95$) within the sulphur-fertilised variants was detected only in the variant top-dressed with S^0 (see Tab. V and Fig. 5).

The quality of white mustard seed is also limited by the proportion of greyish seeds. According to Kebert (1993) more than 8% considerably reduces the quality of the final product. The greyish shade is caused by mycelia of mildew which increase with the dose of nitrogen or higher seeding amount (Mikšík et al., 2007). An application of sulphur could have a positive effect on this undesirable phenomenon. In the pot experiment we managed a significant reduction in the proportion of greyish (mouldy) seeds by applying sulphur, i.e. from 5.43% in the variant not fertilised with sulphur to 4.65–4.58% in variants where sulphur was applied in the soil to 4.08% in the variant with foliar S^0 application. It has long been known that foliar-applied S^0 has fungicidal effects. Indeed, S^0 was recommended for control of plant diseases at the beginning of the 19th century (Forsyth, 1802) and by the early 1900s it was the most important fungicide until the development of organic S-fungicides in the 1950s (Tweedy, 1981). But the S nutrition of the crop can also have an impact on plant diseases. Indeed, soil-applied S was found to increase resistance against a variety of fungal pathogens in different crops under glasshouse and field conditions (Schnug et al., 1995; Bourbos et al., 2000; Wang et al., 2003; Klikocka et al., 2005).

When evaluating the agrochemical analysis of the soil after harvest (Tab. VI) we saw acidification



3: *Yields of seeds and straw of white mustard*

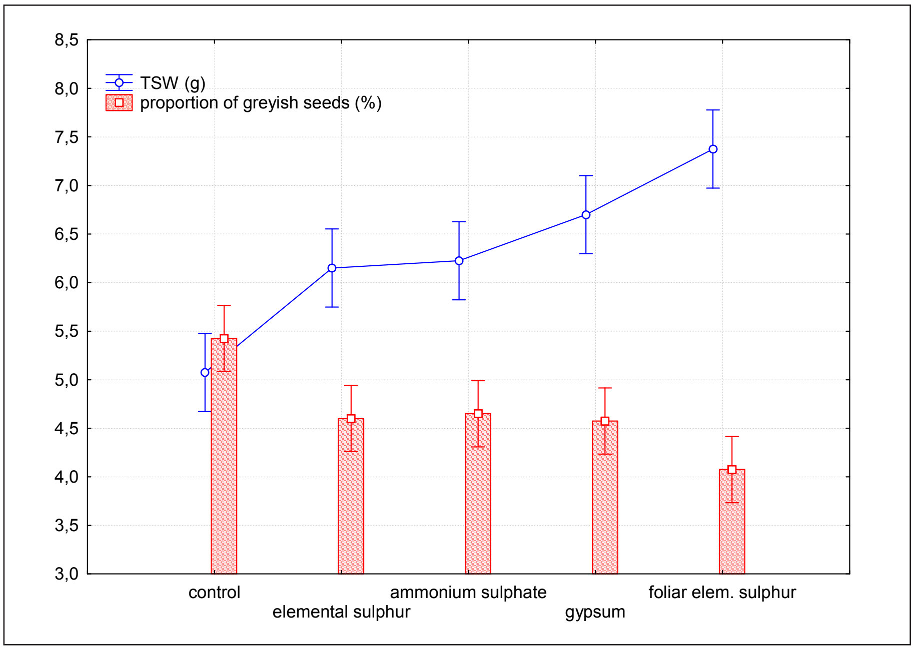


4: *Oil content in seeds of white mustard*

in the exchangeable soil reaction particularly after the application of ammonium sulphate. On the contrary the gypsum variant retained the highest level of pH/$CaCl_2$ followed by the variant top-dressed with S^0. These data closely correspond with the highest levels of available calcium in these variants compared to the lower content of calcium in the variants with ammonium sulphate and subsequently with elemental sulphur in the soil.

Foliar application of S^0 resulted in the highest yields and the second highest oil content. On the other hand the soil had the lowest post-harvest content of available sulphur and phosphorus which means that foliar application of sulphur enhanced yields and the quality and thus an increased intake of necessary nutrients from the soil.

The gypsum variant provided the highest amount of sulphur available for the subsequent crops.



5: *Thousand-seed weight (TSW) and proportion of greyish seeds of white mustard*

CONCLUSION

The effect of two forms of sulphate sulphur and two forms of elemental sulphur (S^0) on yield parameters was significant only in terms of the seed yields. The maximal yield of white mustard seeds was achieved after foliar application of S^0, which is due not only to its nutritional but also fungicidal action. The highest average number of branches and pods and highest straw yields were recorded in the gypsum variant.

To produce high-quality mustard the seeds must contain not less than 25% of oil; mustard seeds of the gypsum variants and after foliar application of S^0 complied.

An important indicator of the seed quality is also the 1000-seed weight. The TSW was again significantly higher after foliar application of S^0.

A specific indicator of the quality of mustard is the degree of mildew attack of the seeds expressed as the amount of seeds greyish on the surface. The proportion of these infested seeds decreased significantly after the application of all forms of sulphur; the best results were achieved in the variant with foliar application of S^0.

Potential acidification of the soil environment as a result of the application of sulphur fertilisers was seen after the application of ammonium sulphate. In contrast, gypsum had an alkali effect on the soil; after it was applied the soil showed the highest content of available calcium, along with the variant using foliar application of S^0.

Gypsum also left the greatest amount of water-soluble sulphur in the soil after mustard was harvested. On the other hand the least amount of available sulphur and phosphorus was discovered in the soil in the variant with foliar application of S^0; this indicated that such an application enhanced the uptake of other nutrients from the soil for building up the yields and the quality of seeds.

SUMMARY

In the past most of the demands of agricultural crops for sulphur had been covered by atmospheric depositions. However, in experimental year 2004 these depositions in the Czech Republic were reduced to 12.1% of the situation in 1990; in 2004 it was only 8.8 kg of S per ha (Hůnová et al., 2005). This rapid drop was the main reason why the use of sulphur-containing fertilisers has increased so much. Apart from standard fertilisers (e.g. ammonium sulphate) we see the comeback of gypsum and newly we can also apply elemental sulphur (S^0) which is available for the plants after its oxidation.
Among plants with high demands for sulphur the most important are plants of the family *Brassicaceae*. In addition to increased acreage of winter rape the acreage of white mustard is gradually increasing too; the Czech Republic is the most important producer and exporter of this crop (Mikšík et al., 2007).
The objective of the present study was to estimate the effect of S^0, ammonium sulphate, gypsum and foliar application of S^0 on yield and qualitative parameters of white mustard seeds.

This topic was studied in the form of a pot trial in a vegetation hall in 2004 and linked up with an identical experiment with spring wheat conducted in 2003. Besides the control variant not fertilised with sulphur (1) we fertilised the soil with S^0 (2), ammonium sulphate (3) and gypsum (4) and foliar dressing using S^0 with bentonite (5). For all variants the nitrogen dose was 0.9 g per pot (0.15 g.kg^{-1} of soil) and for variants 2 to 4 it was 1 g of sulphur per pot (0.17 g. kg^{-1} of soil). Foliar application of S^0 was not applied until the stage of six true leaves in a dose of 10 kg per ha (0.032 g per pot).
Significantly higher yields of white mustard seeds were achieved after foliar application of S^0 which can also be due to its fungicide action. The variants where gypsum was applied showed the highest average number of branches and pods per pot and also the highest straw yields. After gypsum fertilisation or foliar application of S^0 the oil content of the mustard seeds exceeded 25%; this is the minimal content required for the production of good quality mustard. The 1000-seed weight was significantly higher after foliar application of S^0. The proportion of seeds greyish on the surface, a sign of mildew, significantly decreased after fertilisation with all forms of sulphur, but most of all after foliar application of S^0.
Fertilisation with ammonium sulphate reduced the exchangeable soil reaction after harvest. On the other hand gypsum alkalised the soil environment and increased the content of available calcium and water-soluble sulphur. The variant using foliar application of S^0 had a higher content of available calcium in the soil after harvest. The least amount of available sulphur and phosphorus in the soil was seen after foliar application of S^0 signalising a more efficient uptake of nutrients from the soil for the production of seed yields and seed quality.

SOUHRN

Vliv hnojení sírou na výnos a kvalitu semen hořčice bílé

V minulosti byla potřeba síry u zemědělských plodin pokryta atmosférickými depozicemi. V experimentálním roce 2004 činily tyto vstupy síry již pouze 12,1 % oproti situaci v roce 1990, což bylo pouhých 8,8 kg síry na hektar (Hůnová et al., 2005). Tento rapidní pokles byl hlavním důvodem pro rozvoj používání sirných hnojiv.
Kromě klasických hnojiv (např. síran amonný) je možné pozorovat návrat sádrovce a nově je možné použít také elementární síru (S^0), která je rostlinami přijatelná až po její oxidaci.
Mezi plodinami náročnými na síru hrají hlavní roli rostliny z čeledi brukvovité. Vedle nárůstu ploch řepky ozimé dochází k postupnému nárůstu ploch hořčice bílé a Česká republika je její nejvýznamnější pěstitel a exportér (Mikšík et al., 2007).
Cílem prezentované práce bylo posoudit vliv S^0, síranu amonného, sádrovce a foliární aplikace S^0 na výnos a kvalitativní parametry semen hořčice bílé.
Problematika byla řešena v roce 2004 formou nádobového pokusu ve vegetační hale MZLU v Brně, který navazoval na stejný pokus s pšenicí jarní v roce 2003. Kromě sírou nehnojené kontrolní varianty (1) bylo provedeno hnojení S^0 (2), síranem amonným (3) a sádrovcem (4) do půdy a foliárně S^0 s bentonitem (5). Dávka dusíku činila u všech variant 0,9 g na nádobu (0,15 g.kg^{-1} zeminy) a u variant 2 až 4 byla dávka síry 1 g na nádobu (0,17 g. kg^{-1} zeminy). Foliární aplikace S^0 byla provedena až ve fázi šesti pravých listů v dávce 10 kg na ha (0,032 g na nádobu).
Průkazně vyšší výnos semen hořčice bílé byl dosažen po foliární aplikaci S^0, což lze vysvětlit také jejím fungicidním působením. Nejvyšší průměrný počet větví a šešulí a také výnos slámy byl zaznamenán u varianty se sádrovcem. Semena hořčice po hnojení sádrovcem nebo S^0 foliárně přesáhla 25% obsah tuku, což je minimální hodnota pro výrobu kvalitních stolních hořčic. Foliární aplikace S^0 způsobila průkazně vyšší hmotnost tisíce semen. Podíl povrchově zašedlých semen díky jejich zaplísnění průkazně poklesl po hnojení všemi formami síry, nejvíce po foliární aplikaci S^0.
Hnojení síranem amonným působilo na snížení výměnné půdní reakce po sklizni pokusu. Naopak sádrovec půdní prostředí alkalizoval a zvýšil obsah přístupného vápníku a také vodorozpustné síry. Také varianta s foliární aplikací S^0 vykázala vyšší obsah přístupného vápníku v půdě po sklizni. Nejméně přístupné síry a fosforu bylo v půdě po foliární aplikaci S^0, což signalizuje podporu příjmu živin z půdy pro tvorbu výnosu semen a jejich kvalitu.

hořčice bílá, elementární síra, síran amonný, sádrovec, výnos, kvalita

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