

Effect of different sulphur fertilizers, depending on application time and nitrogen fertilization, on yield and seed quality of winter rapeseed

Feng Yan¹, Diedrich Steffens², Katja Michaelis² and Bernd Honermeier¹

¹Institute of Agronomy and Plant Breeding I, Justus Liebig University of Giessen, Schubertstrasse 81, D-35392 Giessen, Germany,

²Institute of Plant Nutrition, Justus Liebig University of Giessen, Heinrich-Buff-Ring 26-32, D-35392 Giessen, Germany

E-Mail: feng.yan@agr.uni-giessen.de

Introduction:

Availability of sulphur (S) in some soils, particularly in sandy soils, may become a limiting factor for winter rapeseed (*Brassica napus* L.) production. Application of S fertilizer is a farming practise for rapeseed cultivation. The release rate of S from fertilizer depends strongly on aggregate states of the fertilizers. Powder fertilizer releases S more quickly and may cause S leaching when applied in the autumn, while granulate fertilizer releases S slowly and may reduce the S loss by leaching. In the present study, we compared the effects of two S fertilizers on rapeseed yield and seed quality by monitoring S movement in the soil profile and S availability for winter rapeseed on a sandy soil.



Fig. 1: Granulate aggregate of S fertilizer BASS 6 on the soil surface (left), which was porous and easily dis-aggregated by pressure (right). The fertilizer was applied in Sept. 2016 and the photo was taken in Feb. 2017.

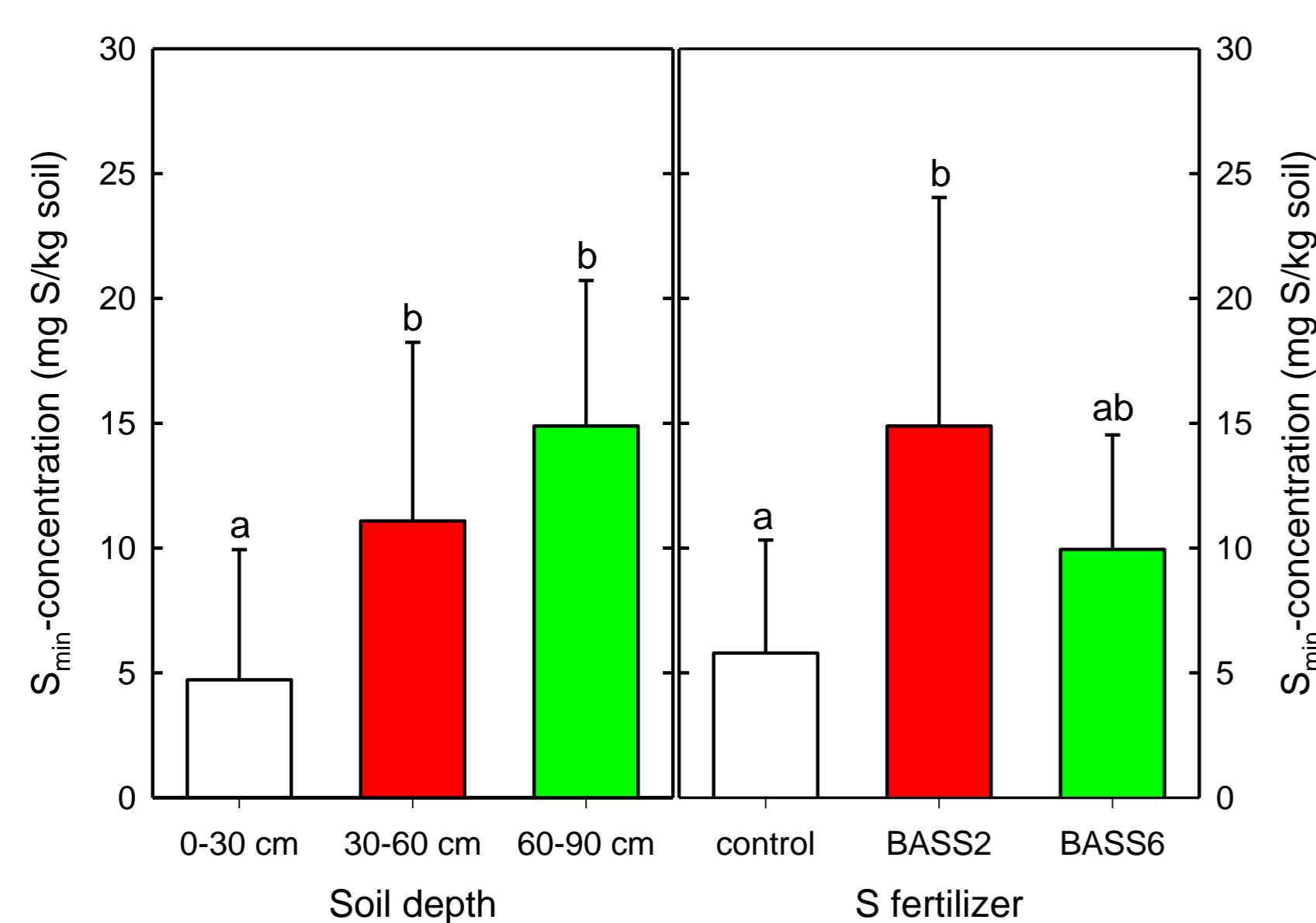


Fig. 2: S_{min} concentration in different soil depths (left) and among treatments with different S fertilizers (right). The fertilizers were applied in Sept. 2016 and soil samples were taken in Feb. 2017. Different letters indicate significant differences among different treatments ($p < 0.05$).

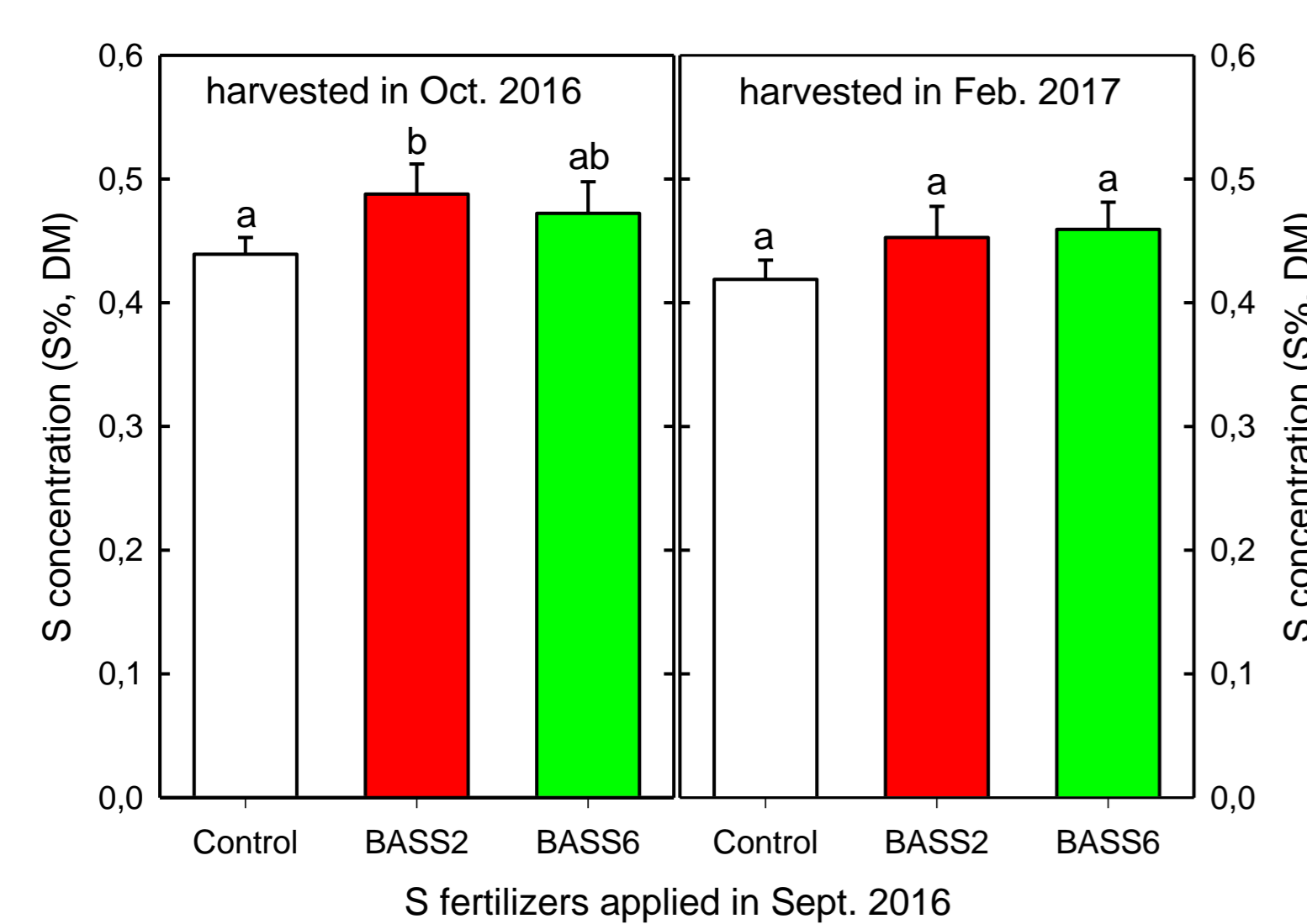


Fig. 3: S concentration of rapeseed plant cultivated with different S fertilizers. The plants were harvested in Oct. 2016 (left) and in Feb. 2017 (right), respectively. The fertilizers were applied in Sept. 2016. Different letters indicate significant differences among different treatments ($p < 0.05$).

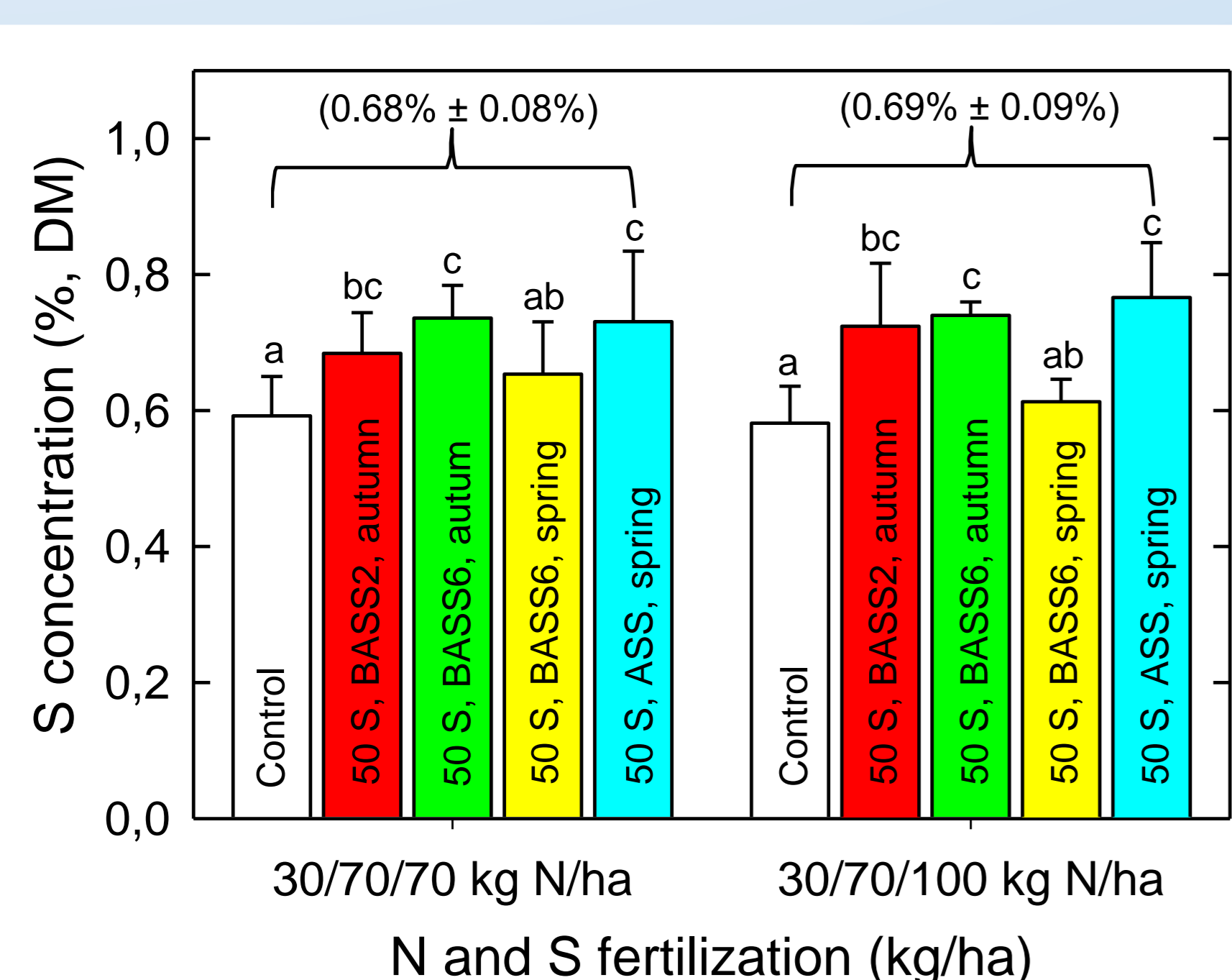


Fig. 4: S concentrations of rapeseed plants harvested at flowering stage on 25th April 2017. The S fertilizers were applied either in Sept. 2016 (autumn) or in Mar. 2017 (spring). Different letters indicate significant differences among different treatments ($p < 0.05$).

Material and Methods:

Field experiment:

2016/2017, South Hesse, Germany

Experiment design:

Randomized block design, $n = 4$

Test factors:

S fertilizers and N doses

S fertilizers:

S1: Control (without S)
S2: 50 kg S/ha, BASS2 (powder) applied in autumn
S3: 50 kg S/ha, BASS6 (granulate) applied in autumn,
S4: 50 kg S/ha, BASS6 (granulate) applied in spring
S5: 50 kg S/ha, ASS (ammonium sulfate nitrate),
applied in spring

N doses:

N1: 30/70/70 kg N/ha in autumn, two times in spring
N2: 30/70/100 kg N/ha, in autumn, two times in spring

Results and Discussions:

(1) Differences in dissolution:

In comparison with powder S fertilizer (BASS2), granulate S fertilizer (BASS6) dissolved slowly and fertilizer grains were visible in the spring of 2017 (Fig. 1), though applied in autumn of 2016.

(2) Sulfate leaching:

Leaching of sulfate over winter was indicated by increasing S_{min} concentration with increasing soil depth (Fig. 2, left). The S_{min} concentration in BASS2 treated soil was significantly higher than that of control (Fig. 2, right), while granulate fertilizer (BASS6) caused only a moderate increase in S_{min} concentration.

(3) S nutrition of rapeseed plants:

Difference in dissolution rate between BASS2 and BASS6 was reflected by S concentration in rapeseed plants in autumn 2016 and in spring 2017 (Fig. 3). At flowering stage, rapeseed plants reached the maximum of biomass and accumulation of nutrients. In comparison with control, a significantly higher S concentration was estimated in plants from treatments of BASS2 and BASS6 applied in autumn, and ASS applied in spring (Fig. 4). In contrast, BASS6 applied in spring resulted in a comparable S concentration of plants in control. N concentration in the plant shoots increased with the increasing rates of N application, irrespective of S fertilization (Fig. 5).

(4) Rapeseed yield and quality

The rapeseed yield was not influenced by S fertilization. In contrast, higher nitrogen application resulted in a significantly higher seed yield (Fig. 6). The oil concentration of rapeseed was slightly lower for BASS6 fertilizer applied in the spring. Other S treatments showed no effect on oil concentration (Fig. 7). In addition, higher nitrogen application rate resulted in a significantly lower oil concentration (Fig. 7) and higher protein concentration of rapeseed (data not shown).

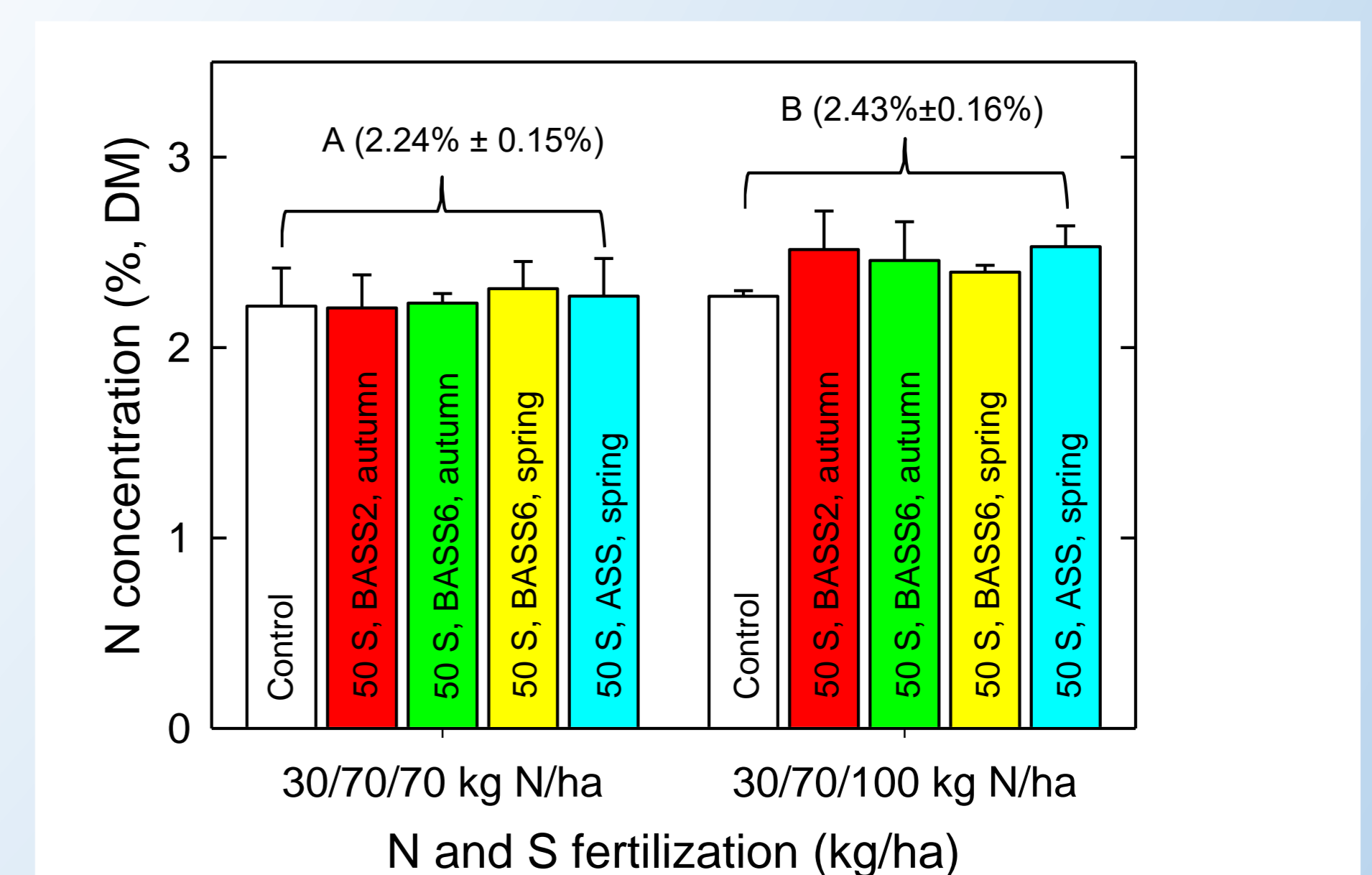


Fig. 5: N concentrations of rapeseed plants harvested at flowering stage on 25th April 2017. The S fertilizers were applied either in Sept. 2016 (autumn) or in Mar. 2017 (spring). Different letters indicate significant differences among different treatments ($p < 0.05$).

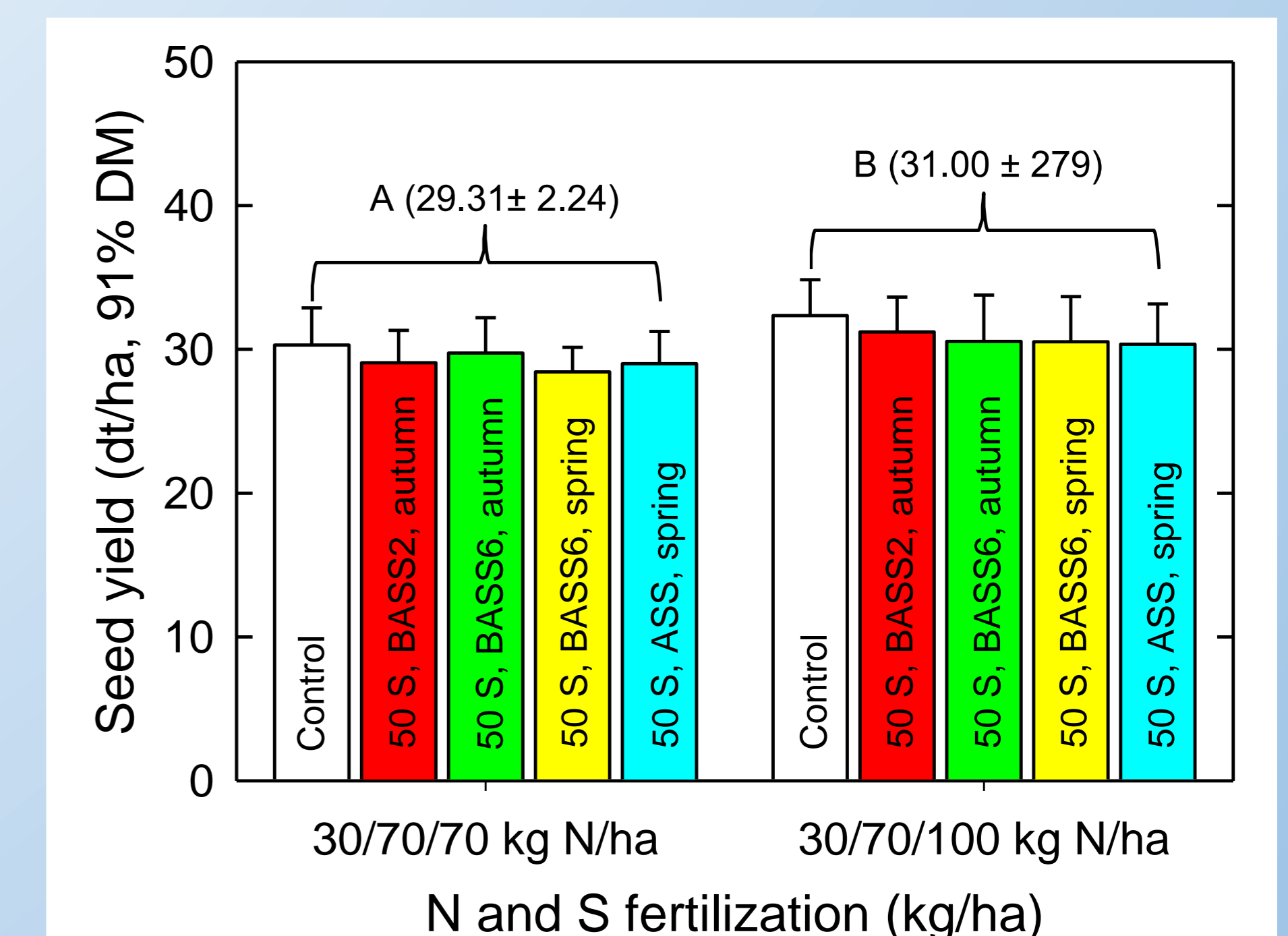


Fig. 6: Seed yield of rapeseed in dependence of N and S fertilization. The S fertilizers were applied either in Sept. 2016 (autumn) or in Mar. 2017 (spring). Different letters indicate significant differences among different treatments ($p < 0.05$).

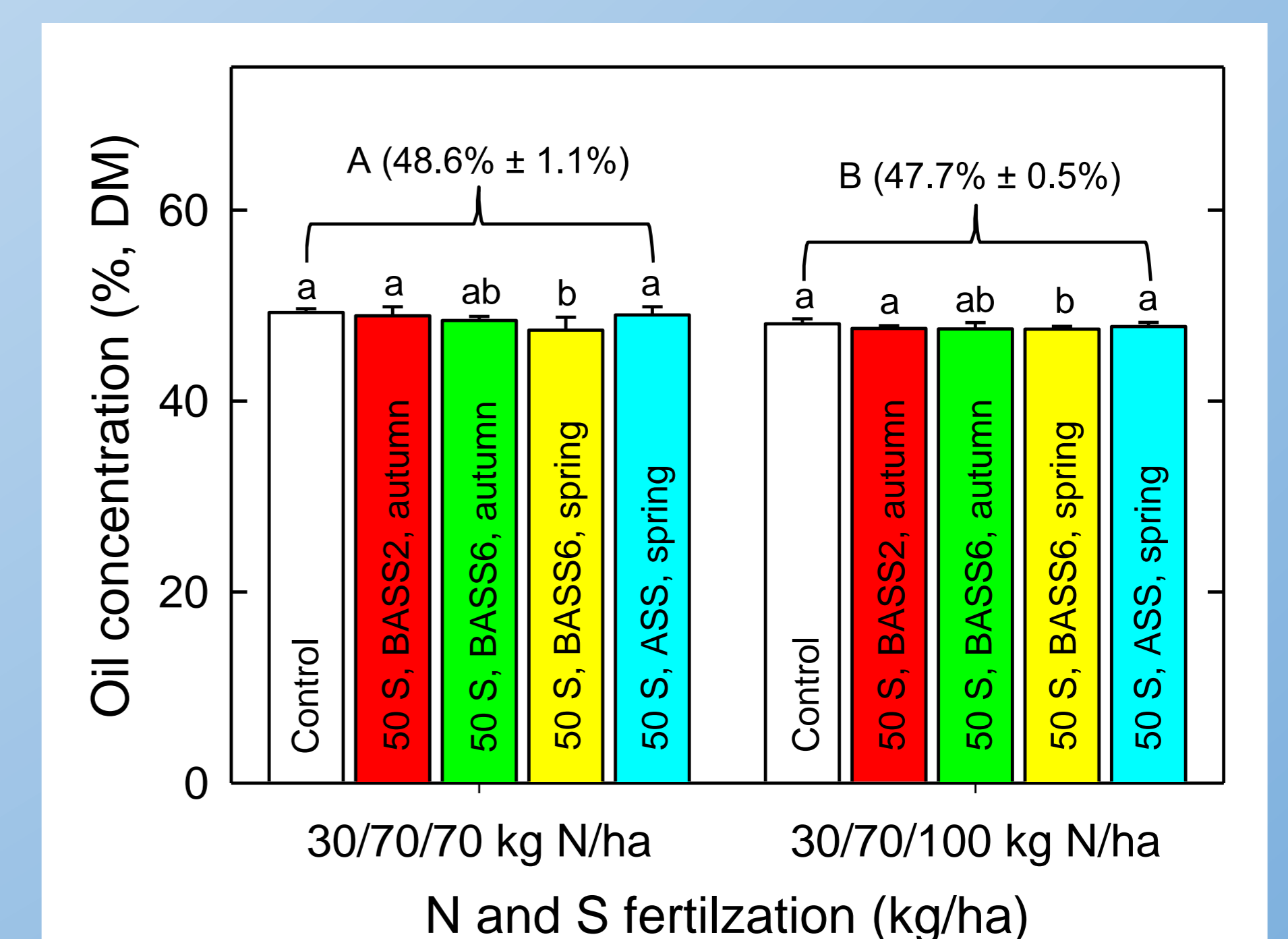


Fig. 7: Oil concentrations of rapeseed in dependence of N and S fertilization. The S fertilizers were applied either in Sept. 2016 (autumn) or in Mar. 2017 (spring). Different letters indicate significant differences among different treatments ($p < 0.05$).

Conclusion:

Granulate S fertilizer releases S more slowly as compared with powder S fertilizer. This can reduce the S loss due to leaching over winter period and increase S concentration in rapeseed plants at young stage and flowering stage. This is independent of nitrogen supply. The application of granulate fertilizer BASS6 in spring is not advisable due to its slow release rate of S. In the present study, no effect of S fertilization on seed yield or seed quality was observed, though a slightly lower oil concentration was estimated, when BASS6 applied in spring.