

SUMMARY

YIELDING EFFICIENCY OF SULFUR AND NITROGEN IN THE PRODUCTION OF SPRING RYE

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A strict 3-year field experiment was conducted in order to identify the impact of sulphur fertilization on the yield and quality of spring rye and on the content and accumulation of total nitrogen and sulphur in the plant. The subject of experiment was spring rye (*Secale cereale* L.) cv. Bojko fertilized with different rates of nitrogen (factor I) and sulphur (factor II). The experiment was carried out in the years 2009-2011 according to the split-plot method on a private farm in Malice near Hrubieszów, on medium brown dystrophic typical soil (BDt) consisting of medium granular sandy clay [PTG 2008], classified as good rye complex. The forecrop was potato, which was fertilized with cattle manure at a rate of 30 t ha¹.

The experiment included 2 factors (in four replications):

1. Nitrogen fertilization at rates of 0, 30, 60, 90 kg·ha⁻¹
2. Sulphur fertilization at rates of 0, 40 kg·ha⁻¹

In three stages of the spring rye growing season samples of plant material were collected and analysed for yield of dry matter (1- BBCH 30-31: leaves, 2- BBCH 55-59: whole plants, 3 - BBCH 89-92: grain and straw). Content and accumulation of total N and S were determined in the dry matter of grain and straw samples. The following yield components were determined before harvesting: 1,000 grain weight (g), grain number per ear, number of ears per m², ear length (cm) and plant height (cm). After harvesting the grain yield from each plot was determined and expressed in t ha⁻¹ (at 11% moisture content).

Content of total protein and starch were determined in the grain samples, as well as the falling number. The following parameters of nitrogen and sulphur fertilization were calculated: agronomic efficiency, physiological efficiency, harvest index of N and S, utilization of N and S, the final efficiency index of N and S.

The experiment showed that spring rye cv. Bojko showed a positive reaction to the nitrogen and sulphur fertilization, expressed as yield size and quality. The most beneficial effect on the grain yield of the spring rye and its structure and on the biometric features and technological and chemical quality of the grain was observed for nitrogen application (factor I) at a rate of 60 and 90 kg ha⁻¹ and for sulphur (factor II) at a rate of 40 kg·ha⁻¹. Application of 30 kg N ha⁻¹ was insufficient for realization of yielding potential, irrespective of the addition of sulphur. The yield characteristics and grain quality of the spring rye were more strongly influenced by nitrogen fertilization and its interaction with weather conditions than by sulphur fertilization. In stages BBCH 30-31 and BBCH 55-59 was observed an increase of biomass yield in proportion to the N rate, and the addition of sulphur in both cases contributed to increases in these characteristics. Applied fertilization generally favoured the accumulation of total nitrogen and total sulphur. Accumulation of nitrogen and sulphur were significantly dependent on nitrogen fertilization and averaged 28,45 kg N t⁻¹ and 2.45 kg S t⁻¹. Nitrogen and sulphur fertilization were not affected significantly on the nitrogen harvest index, whereas it decreased the sulphur harvest index. On average, nitrogen harvest index was 75.85% and sulphur harvest index 46,32%. Among the tested combinations the highest agronomic and physiological efficiency of nitrogen utilization were noted for the object where nitrogen fertilization increased to 60 kg·ha⁻¹ with addition of 40 kg S ha⁻¹. Taking into account all the nitrogen and sulphur tested combinations, the highest nitrogen utilization and the best final efficiency index were also obtained after the combined application of 60 kg N ha⁻¹ and 40 kg S ha⁻¹. This combination should be recommended for use in the practice of nitrogen and

sulphur fertilization of spring rye. Increasing the rate of nitrogen fertilizer to $90 \text{ kg}\cdot\text{ha}^{-1}$ causes a reduction in nitrogen utilization, and the addition of sulphur to this level of nitrogen causes a drop in its utilization by the grain. In conclusion, sulphur fertilization is necessary in the conditions of negative sulphur balance in the cultivated soils. As Polish agriculture is changing over to an integrated production system, it is proposed that the variant of 60 kg N ha^{-1} in conjunction with 40 kg S ha^{-1} should be recommended for use in this production system of spring rye.

Key words: spring rye, sulphur, nitrogen, yield, quality, fertilization efficiency