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INFLUENCE OF NITROGEN ON SULPHUR ADOPTION OF WINTER WHEAT AND TRITICALE

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SUMMARY: Nitrogen is the most important element for high yield and in addition affects the adoption and accumulation of certain ions in plants, including sulphur. The aim of this paper was to examine the effect of increasing quantities of nitrogen fertilizer on sulphur adoption of winter wheat and triticale and to find optimum doses of nitrogen that can give good grain quality. A two year stationery trial with increasing quantities of N (0, 50, 100 and 150 kg ha^{-1}) and three varieties of wheat and one of triticale was performed at the experimant field of the Institute of Field and Vegetable Crops in Novi Sad. The grain sulphur content of the winter wheat and triticale grew with increasing doses of nitrogen fertilizers. The grain sulphur content of all cultivars responded positively to the increasing nitrogen quantities up to the rate of 100 kg ha^{-1} N in first and 150 kg ha^{-1} in second year of examination. It was determined that the genotypes responded differently to different rates of nitrogen fertilizers when it came to their sulphur contents. The present study showed that by using the right quantities of nitrogen fertilizer we can optimize the fertilization in wheat production with proper environmental care.
Key words: nitrogen, sulphur, winter wheat, triticale.

Introduction

The genetic potential for yield and grain quality can be realized only in conditions of appropriate agronomic practice, where particular attention must be paid to mineral nutrition, most importantly that involving nitrogen.
Nitrogen is essential element for plants and the most important element for rapid increases of crop yield. Nitrogen enters into the composition of many compounds important to life processes of plants: proteins, nucleic acids, nucleotides, chlorophyll etc [1]. Different levels of nitrogen provision primarily reflects the synthesis of structural and catalytic proteins or enzymes, many of which participate in the construction of the photosynthetic apparatus and the process of photosynthesis.
In addition, nitrogen affects the adoption and accumulation of certain ions in plants, including sulphur [2]. Sulphur, the fourth most abundant macro-element in crops is found primarily in organic forms as amino acids (methionine, cystine, cysteine) which together with lysine are sometimes are synthesized in amounts that limit plant growth [3]. Furthermore, in winter wheat the S-S cross binding of the gluten components (cystine) plays a vital role in forming a suitably structured soft part of bread [3]. The effects of nitrogen (N at 0, 100 and 180 kg N ha-1) on content of sulphur of two bread wheat cultivars showed significant increase of S concentration in the grains with the amount of applied N [4]. The aim of this paper was to examine the effect of increasing quantities of nitrogen fertilizer on sulphur adoption of winter wheat and triticale. The goal was to find optimum doses of nitrogen that can give good grain quality with proper environmental care.

Material and methods

Effects of increasing quantities of nitrogen fertilizer on sulphur adoption were examined during 2002 and 2003 at the experiment field of the Institute of Field and Vegetable Crops in Novi Sad. The experiment was arranged in a randomized complete block design with two factors and four replications. The soil was a calcareous chernozem.
The experimantal material consisted of three winter wheat cultivars: Sonata, Durumko, Pobeda and one triticale cultivar Novosadski triticale, each of which has different agronomic, physiological and technological characteristics.

Original scientific paper
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Nitrogen fertilizers was applied in different doses of nitrogen: 0, 50, 100 and 150 kg ha^{-1}. The usual cultural practices were applied. One half of the nitrogen fertilizer were applied in the autumn, while the other half of N was incorporated in the spring.

The plant samples were collected at maturity, air dried and milled in a plant material mill. The sulphur content in wheat grain was determined by CHNSO elemental analyzer accroding to the AOAC Official Method 972.43:2000, Automated Method, in Official Methods of Analysis of AOAC International.The results were processed by statistical methods by variance analisys (Statistica 9.0). Significance of differences was tested with Duncan's test.

Results and discussion

Both the effect of the variety and that of fertilisation on S content in grain are statistically significant (Tab. 1 and 2). The sulphur content increases due to application of of N-fertilisers [3]. The mean value of S-content (calculated from all varieties) for the lowest fertilisation rate is siginficantly higher then that of the control. In our study, the medium dose of N significant increased grain sulphur content by an average of 0.022% for both years relative to the control. In the first year the increase of grain sulphur content for the medium fertilization rate relative to lowest one was siginficant, but this was not the case in the second year.

Table 1. Effect of N rates on winter wheat and triticale grain sulphur content (%) in 2002.

N rates (kg N ha−1)	Sonata	Durumko	Pobeda	Novosadski triticale	Mean
N 0	0.173^{abc}	0.153^{dc}	0.116^{g}	0.117^{g}	0.140^{c}
N 50	0.171^{abcd}	0.144^{ef}	0.160^{bcde}	0.130^{fg}	0.151^{b}
N 100	0.188^{a}	0.171^{abcd}	0.168^{bcd}	0.152^{de}	0.170^{a}
N 150	0.176^{abc}	0.177^{ab}	0.157^{cde}	0.165^{bcd}	0.168^{a}
Mean	0.177^{a}	0.161^{b}	0.150^{c}	0.141^{d}	

Significance of differences was tested with Duncan's test, $p < 0.05$;

The highest S-content was measured in the treatment in which 150 kg ha^{-1} of N fertilizer were applied in second year, with the difference being significant relative to the lower treatment and the control. In first year of examination this level of applied nitrogen was not different from the lower treatment. There was also significant difference in grain sulphur content between the cultivars on different level of fertilizers.

The effects of increased doses of nitrogen on content of sulphur was confirmed with two bread wheat cultivars and this concentration raised with the amount of applied N to the level 180 kg/ha of applied N [4]. Grain qualities in four cultivars of durum wheat, subjected to four different nitrogen (N) treatments in field trials conducted in two succes years, were influenced by N-fertiliser application [2].

Table 2. Effect of N rates on winter wheat and triticale grain sulphur content (%) in 2003.

N rates (kg N ha−1)	Sonata	Durumko	Pobeda	Novosadski triticale	Mean
N 0	0.142^{h}	0.174^{cdef}	0.152^{gh}	0.150^{gh}	0.155^{c}
N 50	0.152^{gh}	0.163^{efg}	0.159^{fgh}	0.186^{bc}	0.165^{b}
N 100	0.160^{fgh}	0.195^{b}	0.154^{gh}	0.170^{defg}	0.170^{b}
N 150	0.230^{a}	0.184^{bcd}	0.155^{fgh}	0.180^{cde}	0.188^{a}

Mean	0.171[a]	0.179[a]	0.155[b]	0.172[a]	

Significance of differences was tested with Duncan's test, $p < 0.05$;

Due to the different responses of genotypes for grain sulphur content to different rates of nitrogen fertilizers , which have been confirm in the present study as well, an individual approach is required in the case of each genotype[5].

Conclusion

The grain sulphur content of all the wheat cultivars and triticale responded positively to the increasing nitrogen quantities to the rate of 100 kg ha^{-1} N in first and 150 kg ha^{-1} in second year of examination.

Due to the different responses of genotypes for sulphur content to different rates of nitrogen fertilizers, an individual approach is required in the case of each genotype.

The proper management of nitrogen is critical to the success of wheat production and environmental care.

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