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CORRELATION BETWEEN NITROGEN AND CHLOROPHYLL CONTENT IN WHEAT (*Triticum aestivum* L.)

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ABSTRACT: Physiological investigations of nitrogen content and relation between nitrogen and chlorophyll content at some wheat cultivars were carried out at the outset of the flowering phase. Dependence of nitrogen content from mineral elements in the soil was established at the same time. Investigations were guided on unfertilized soil and four fertilization variants (N, NPK, NP and NK). The results indicated that nitrogen content influenced from presence and ratio mineral elements in the soil. The most favorable variant of fertilization was NPK and the most unfavorable – unfertilized soil. According to cultivars, KG 100 had the highest nitrogen content and Matica the lowest. Nitrogen content was close link with chlorophyll content. Correlation does not exist only at triticale cultivar Knjaz.

INTRODUCTION

From all metabolic elements which plants use from soil, nitrogen needs in the largest amounts (TUCKER, 2004). Nitrogen exists in organic and inorganic form and the greatest nitrogen content is in seeds, leaves, shoots and roots. Deficiency of nitrogen leads to loss green color in the leaves, decrease leaf area and intensity of photosynthesis. Understanding the processes that govern N uptake and distribution in crops is of major importance with respect to both environmental concerns and the quality crop products. Nitrogen uptake and accumulation in crops represents two major components of the N cycle in the agro system (GASTAL and LEMAIRE, 2002). The relationship between N and biomass accumulation in crops, relies on the reciprocal regulation of multiple crop physiological process. Therefore, N uptake and distribution in plant and crops involves many aspects of growth and development.

Modern technology of wheat production mainly based on numerous scientific farming measures as well as application of mineral fertilizers. Mainly one third of applied nutrient wheat plants are able use during vegetative period. In the filed practices is very important optimize quantity of fertilizers, decrease expenses of production and improve efficiency of wheat plant of nitrogen absorption, accumulation and reutilization. The nitrogen plays main

role in wheat nutrition because of its importance in protein and nucleic acid synthesis as well plant species and cultivars to suboptimal supplies of mineral element, including N, are different (SARIĆ and KOVAČEVIĆ, 1981; CLARK, 1983). Wheat properties are mainly caused by effect of genetic factors in interaction with environment (PEPO, 2005; BALOGH *et al*., 2006). The total N content represent indicator of N accumulation in plant (DESAI and BATHIA, 1978) which indicating root system activity and translocation of organic and inorganic matter to top of plant. Physiological N efficiency in plant indicating activity of top of plant and involve of absorbed N into processes of synthesis.

Leaves exhibit a structural and functional acclimation of the photosynthetic apparatus to the light intensity experienced during their growth (PRIOUL *et al*., 1980). Nitrogen supply has large effect on leaf growth because it increases the leaf area of plants and, on that way, it influences on photosynthesis. Photosynthetic proteins represent a large proportion to total leaf N (EVANS, 1989; FIELD and MOONEY, 1986). Chlorophyll content is approximately proportional to leaf nitrogen content, too (EVANS, 1983).

MATERIAL AND METHODS

Experimental design

The experiment was conducted on winter wheat (*Triticum aestivum* L.) in 2002 and 2003 on agricultural field located in Small Grains Research Center of Kragujevac. The soil type is smonitza in degradation. Complex physiological investigations were carried out on material taken from a five test micro plots of 100 m^2 wide. In the present study, terminal leaves of six wheat cultivars (*Lazarica, Studenica, Matica, Takovčanka, KG 56* and *KG 100*) and one cultivar of triticale (*Knjaz)* were used as material. Sampling of flag leaves began after they had reached full expansion in flowering stage. Under field conditions, we measured nitrogen content in flag leaf at different wheat cultivars and their responses to different variants of fertilization were studied.

For analysis of nitrogen content, samples were taken from four basic variants of soil fertilization. Each parcel was given same amounts of ammonium nitrate (27% N), super phosphate (45% P_2O_5) and potassium chloride (60% KCL). Unfertilized soil (control variant) belongs to the smonitza type in the process of degradation, with following characteristics: weak acid reaction with pH value in water from 6.03 to 6.10 and from 4.76 to 4.84 in KCL. Content of total nitrogen is from 0.11 to 0.15 %, accessible P_2O_5 less than 1.0 mg/g and accessible K_2O from 10.3 to 11.1 mg/g of soil (JELIĆ, 1990).

Nitrogen content in leaf was determined by digesting the samples in sulfuric acid (H_2SO_4) followed by analysis of total N by the Kjeldahl method (BREMNER and MULVANEY, 1982). Chlorophyll content was determined by spectrophotometric method and calculating according WELLBURN (1994). Statistical elaboration date was done by multifactorial analysis ANOVA.

RESULTS AND DISCUSSION

At all wheat cultivars nitrogen content was the lowest on unfertilized soil. Meanwhile, at the triticale sort *Knjaz* we measured higher nitrogen content than on the mainly fertilization variants (Tab. 1). The highest N content measured at *KG 56* cultivar on the soil which fertilized with nitrogen only (3.44 %) and the lowest at *Matica* cultivar on unfertilized soil (1.82 %).

Table 1. - Nitrogen content in terminal leaf in flowering phase

Cultivars	TOTAL NITROGEN (N) %					
	Variants of fertilization					
	O	**N**	**NPK**	**NP**	**NK**	***Average***
Lazarica	2,24	2,78	3,33	2,63	3,18	2,83
Studenica	1,95	2,87	2,97	2,95	3,02	2,75
Matica	1,82	2,57	2,78	2,72	2,57	2,49
Takovčanka	2,26	2,83	3,09	2,80	2,79	2,75
KG 56	2,23	3,44	3,18	3,08	2,23	2,83
KG 100	2,42	2,92	3,07	2,80	2,98	2,84
Knjaz	2,87	2,43	2,47	2,93	2,73	2,69
Average	2,26	2,83	2,98	2,84	2,79	

Each cultivar had different nitrogen content on fertilization variants of soil. So, *Lazarica, Matica, Takovčanka* and *KG 100* cultivars had the highest N content on NPK variant (from 3.07 to 3.33 %), *Studenica* cultivar on NK variant (3.02 %) and triticale cultivar *Knjaz* on NP variant (2.93 %). It mean that mineral nutrition has very positive effect on nitrogen content. Winter wheat consumes relatively large amounts of mineral elements for its vegetation. From all macrometabolic elements, wheat consumes nitrogen in the greatest quantites, potassium in somewhat smaller amounts and phosphorus in the smallest amounts. In dependance of type, weather conditions and other factors, soils generally lack nitrogen and phosphorus in greater measure and potassium in less extent. An especially small share of the main nutritive elements is in forms readily accessible to the plant. For this reason, wheat responds very positively to application of mineral fertilizers. So, deficiency of mineral elements is virtually non existent today. Nitrogen content in the plant dependance from nitrogen content in the soil. Meanwhile, nitrogen uptake is much better with addition phosphorus and potassium in the soil.

On the same fertilization variant all the cultivars had different N content, too. It mean that genetic factors and sort specificity had significant role in nitrogen content as a mineral nutrition.

Therefore, average values for fertilization variants show us that NPK variant was the most favourable for N content (2.98 %), while the unfertilized soil was the most unfavourable (2.26 %).

Statistically, mineral nutrition had a greater importance on the nitrogen content than traits of cultivars (Tab. 2). Factor *F* was greater than *Fcrit* for variants of fertilization and much smaller for cultivars at both of level (0.01 and 0.05).

One of the aim of experiment was to assess the influence of wheat cultivars on the relationship between chlorophyll content and nitrogen status in the leaf. In these investigations we confirmed a very close link between chlorophyll and nitrogen content in the flag leaf. This correlation was determined by Pearson (P e t z, 1985). At all the examined cultivars correlation existed exept triticale cultivar where it was not (Fig. 1). The greatest value for link obtained at *Studenica* cultivar (r = 0.97) and the smallest at *Matica* cultivar (r = 0.60).

Table 2.- Statistical analysis obtained date

ANOVA			at alpha 0.01			
Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Var. of fertilization	2,2124	4	0,5531	6,4047	0,0012	4,2184638
Cultivars	0,4564	6	0,0761	0,8809	0,5237	3,66671316
Error	2,0726	24	0,0864			
Total	4,7415	34				

ANOVA			at alpha 0.05			
Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Var. of fertilization	2,2124	4	0,5531	6,4047	0,0012	2,77628942
Cultivars	0,4564	6	0,0761	0,8809	0,5237	2,50818744
Error	2,0726	24	0,0864			
Total	4,7415	34				

Very close link between chlorophyll and nitrogen content many investigators proved (EVANS, 1983; FILED and MOONY, 1986; AMALIOTIS *et al*., 2004). It is understandable, because nitrogen is a structural element of chlorophyll and protein molecules, and thereby affects formation of chloroplasts and accumulation of chlorophyll in them (TUCKER, 2004; DAUGHTRY, 2000).

Nitrogen content in the leaf was in relation with colour of leaf (C a b r e r a, 2004). In present study, cultivars which had higher nitrogen content (*KG 100, Lazarica* and *KG 56*) were a dark green. Contrary, *Knjaz* and *Matica* cultivars had a light green colour of leaves and nitrogen content was decrease in these cultivars.

Because a close link between chlorophyll and nitrogen content exist, scientists developed new non destructive method for determination chlorophyll content in the plant. It is a chlorophyll meter. On that way it is possible to order the level supplied of plants with nitrogen (MONJE and BUGBEE, 1992).

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Fig. 1 - Correlation between nitrogen and chlorophyll content