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SOME WHEAT LEAF CHARACTERISTICS IN DEPENDENCE OF FERTILIZATION

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ABSTRACT. The greatest part of yield of cultivated plants is known to result from work of the photosynthetic apparatus, in which the chlorophyll molecule occupies a key place. In this paper, photosynthetic pigments content, leaf surface and dry matter weight were investigated in the terminal leaf of wheat cultivars. Investigations were included five wheat cultivars which grew on the unfertilized and four fertilization variants of soil. All measurements were performed in wheat flowering phase. Results of investigation showed that fertilization had a great influence on examination parameters. The greatest amounts of chlorophyll and carotenoids content were measured at plants cultured on the soil fertilized with nitrogen and phosphorus as well as dry matter weight. Leaf surface extent was the biggest on the variant fertilized with nitrogen and potassium. Nitrogen fertilization variant was next favorable variant.

INTRODUCTION

Leaf is the most important part of photosynthetic apparatus and it has the main role in produce organic matter in plants. Leaf characteristics as well as chloroplasts pigments content, leaf area and dry matter weight have the great influence on yield of cultivated plants. During grain formation and plumping wheat is supplied with carbohydrates of current photosynthesis created for the most part by activity in organs uppermost internodes. The leading role in these processes is ascribed to the terminal leaf or flag leaf (Đ o k i ć et al. 1999).

Many authors have established that chlorophyll and carotenoid synthesis is dependent upon mineral nutrition. Nitrogen is structural element of chlorophyll and protein molecules and it thereby affects formation of chloroplasts and accumulation of chlorophyll in them (T u c k e r, 2004; D a u g h t r y et al. 2000). The concentration of this element in green leaves is related to chlorophyll content, and therefore indirectly to one of the basic plant physiological process, photosynthesis (H a b o u d a n e et al. 2002; A m a l i o t i s et al. 2004; L e l y v e l d et al. 2004; C a b r e r a, 2004). Phosphorus has influence on

stability of molecule chlorophyll in plants, especially with advent of unfavorable weather conditions in fall.

Mineral nutrition significantly affects on the dynamics of leaf surface formation and extent leaf area, which is reflected in the sum total of leaf surface, the photosynthetic potential and net of photosynthesis. Of all macro metabolic elements, the greatest influence on development of plants in general and their leaf surface is exerted by nitrogen, whose enhanced by phosphorus and to lesser extent by potassium.

Leaf surface is the basic photosynthetic area. On its extent the water and nutrients supplying have a great influence (B h a g s a r i & B r o w n, 1986). Nitrogen is one of the most effective factors during the whole period leaf growth. Phosphorus and potassium have smaller significance.

Dry matter weight is very important factor for determination mineral elements amounts needs for the photosynthesis. Nitrogen and phosphorus increased synthesis so the plants have a larger dry matter weight.

Chlorophyll concentration, leaf surface and dry matter weight can be use as a potential indicator for nutrients deficiency in the soil (T e j a d a - Z a r c o et al. 2004).

Winter wheat consumes relatively large amounts of mineral elements of its vegetation. In dependence of type, weather conditions and other factors, soils generally lack nitrogen and phosphorus in greater measure and potassium to a lesser 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 nonexistent today. In the last years, an enormous body of experimental date has been accumulated on the mineral nutrition of wheat. From this reason we investigated some photosynthetic characteristics terminal leaf as pigments content, leaf surface and dry matter weight in dependence of fertilization.

MATERIAL AND METHODS

Complex physiological investigations were carried out on material taken from a test plot of the Small Grains Research Center of Kragujevac. Used as material in the present study were terminal leaves of five wheat cultivars (*Lazarica, Studenica. Matica, KG 56 and KG 100*). The material was collected in mid-May 2002, at the outset flowering phase.

Experimental conditions

For analysis pigments content, leaf surface and dry matter weight, samples were taken from five basic variants of soil fertilization (Table 1).

Each parcel was given same amounts of potassium ammonium nitrate (27% N), superphosphate (45% P_2O_5) and potassium chloride (60% KCl). Unfertilized soil belongs of the smonica 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. Contents of total nitrogen is from 0.11 to 0.15%, accessible P_2O_5 less than 1.00 and accessible K_2O from 10.3 to 11.1mg/100g of soil (J e l i ć, 1990).

Table 1. Treatments of fertilization in long-term experiment

Fertilization variant	Nutritiens [kg/ha]		
	N	P_2O_5	K_2O
0	0	0	0
N	150	0	0
NPK	150	80	100
NP	150	80	0
NK	150	0	100

0-unfertilized soil;
N-soil fertilized with nitrogen only;
NPK- soil fertilized with nitrogen, phosphorus and potassium;
NP-soil fertilized with nitrogen and phosphorus;
NK- soil fertilized with nitrogen and potassium

Processing materials

Pigments content was determined by spectrophotometric method (S a r i ć, 1986). The material was processed in the fresh state immediately after collection. After fine chopping, portions weighing 0.5 g were measured of on an analytical balance. The measured of material was then homogenized with the addition of 10 ml 80% acetone. A primary acetone extract contained all chloroplast pigments. The extract was then centrifuged and the obtained supernatant was diluted by adding 9 ml 80% acetone per ml of extract. The extract produced in this way subjected to reading on a spectrophotometer. Pigments content was calculated according to W e l l b u r n (1994). The leaf surface was measured by leaf parameters method (D ž a m i ć et al. 2001).

RESULTS AND DISCUSSION

Pigments content

The results of measuring chlorophyll and carotenoids contents in the terminal leaf in five wheat cultivars are presented in Fig. 1.

The lowest chlorophyll content in all cultivars was recorded on unfertilized soil (values not exceed of 1.5mg/g). The greatest chlorophyll content was measured in leaf of plants that grew on the soil fertilized with nitrogen and phosphorus (NP variant). On this variant, *Lazarica, Studenica* and *Matica* cultivars had maximal values for chlorophyll concentration (from 2.4 to 3.0mg/g). Among the remaing fertilization variants, N variant was the most favourable. On this variant*, KG 56* sort had a maximal chlorophyll content (3.2mg/g). The *KG 100* sort, except on unfertilized soil, had approximately equal chlorophyll concentration on the all variants of soil fertilization (2.2 – 2.3mg/g).

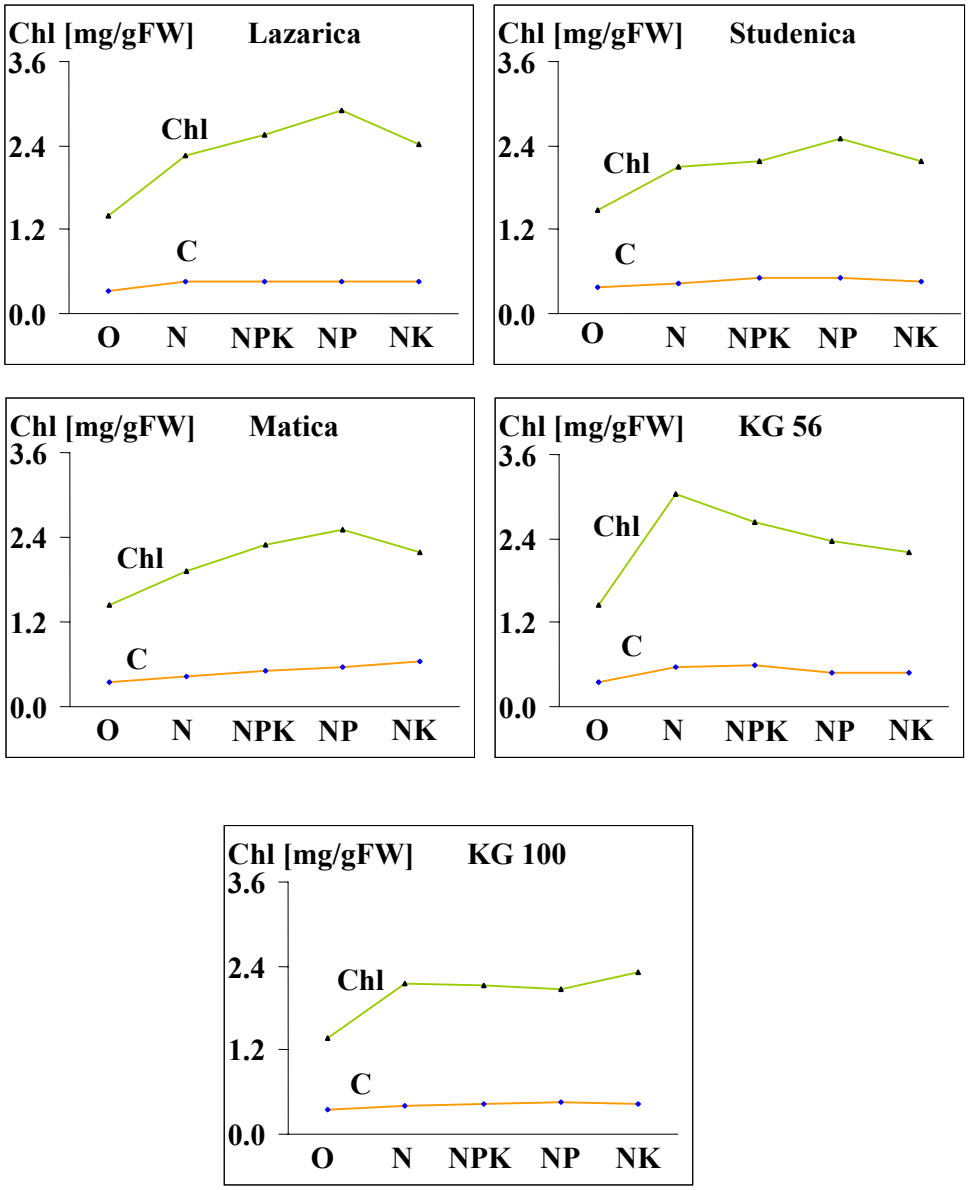

Figure 1. Chlorophyll (Chl) and carotenoid (C) content in flag leaf in dependence of fertilization

The lowest carotenoid content in all examined cultivars of wheat was measured on unfertilized soil, too. On the fertilization variants, carotenoid content showed a little variations in dependence of mineral nutrition. So, *Lazarica, Studenica* and especially *KG 100* cultivars had approximately equal carotenoid content on all fertilization variants (with values between 0.4 and 0.5mg/g). *Matica* cultivar had higher value for carotenoids content on NK variant of fertilization (above 0.6mg/g), while in *KG 56* cultivar the greatest carotenoid content was measured on NPK and N variants. Carotenoids content more depended upon sorts of wheat than fertilization.

The NP fertilization variant (soil to which nitrogen and phosphorus was added) was the most favorable variant for leaf chlorophyll content. This is in keeping with published data indicating that nitrogen and phosphorus exert the greatest influence on chlorophyll content. Nitrogen is a structural element of chlorophyll and protein molecules, and it

thereby affects formation of chloroplasts and accumulation of chlorophyll in them (T u c k e r, 2004; D a u g h t r y et al. 2000). The influence of phosphorus on formation of green pigments in the leaf depends on its concentration. Phosphorus affects the stability of chlorophyll in plants, especially with advent of unfavorable weather conditions in fall.

In some cultivars, the greatest chlorophyll content was measured in leaves of plants that grew on soil fertilized with nitrogen only. Even though nitrogen is the most important mineral element in the process of chlorophyll biosynthesis, adding nitrogen to the soil can have negative as well as positive effects, since an excess of nitrogen shorten the life of leaves, increase their sensitivity, and lower their resistance to plant diseases, which leads to decrease of leaf chlorophyll content. NK variant was unfavorable, because chlorophyll content is known to increase in the presence of a phosphorus deficit. Phosphorus deficiency inhibits plant growth and chlorophyll synthesis, which give plants experiencing it a dark green color. It is interesting that on NPK variant no one cultivars did not have great chlorophyll concentration. This may be explained, so Cl from KCl (which added in soil) can has negative effects on photosynthetic apparatus in plants (J e l i ć et al. 1994).

Leaf surface

Leaf surface depended upon of mineral nutrition very much. The terminal leaf had not the largest surface at all examined cultivars. So, at *KG 100* and *Matica* cultivars second leaf had the largest leaf area (Fig. 2).

For the some wheat cultivars (*KG 100* and *Studenica),* N fertilization variant showed the greatest influence on leaf surface. *Matica* and *Lazarica* cultivars had the greatest leaf surface on the soil fertilized with nitrogen and potassium and *KG 56* cultivar on the NPK variant (32 cm^2).

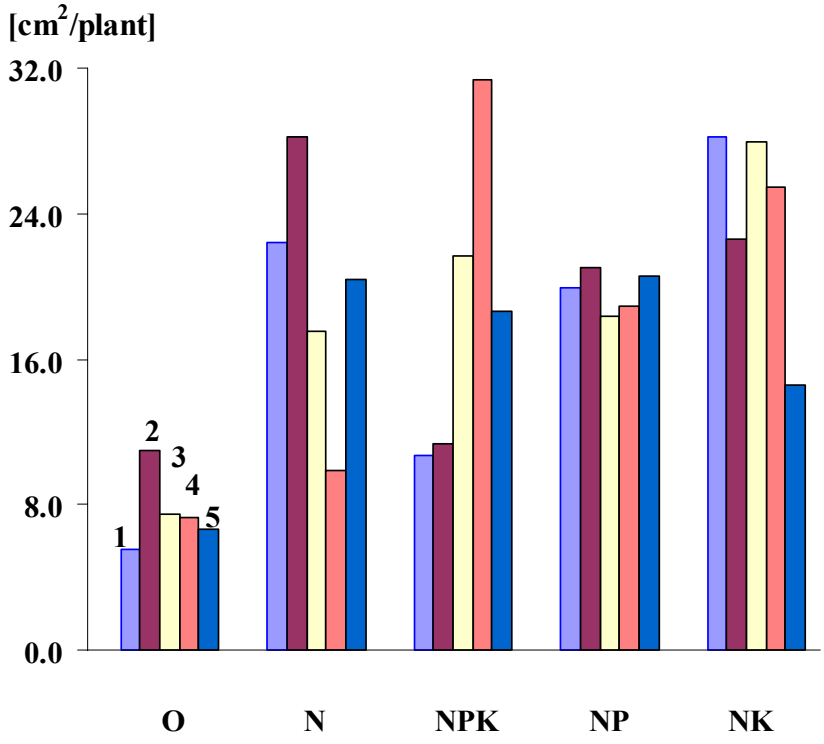

Figure 2. Leaf surface in dependence of fertilization
1-Lazarica; 2-Studenica; 3-Matica; 4-KG 56; 5-KG 100

From published data is known that nitrogen has the greatest influence on leaf extent. This effect is increased by the phosphorus and potassium insignificant. The fertilized variants differenced by growth rapidity and decreased leaf surface especially by the maximum extent. Leaf surface increased more by the phosphorus average 26 – 27% than by the applied nitrogen. Combination with three elements (N, P and K) had not any larger influence on the leaf area by the reason competition of plants toward the light. So, if NPK variant was placed on the edge of experimental parcel, in the favorable light conditions, it is given smaller leaf surface than the rest variants of fertilization. There were differences in dynamic growth and extent leaf surface between the fertilization variants of soil. These differences appeared as consequences different operation by the mineral nutrition on plants growth.

Dry matter weight

Terminal leaf at all the sorts had the largest dry matter weight then second and third leaf. Dry weight of leaf was depended upon the variants of mineral nutrition. *Matica* and *Lazarica* cultivars had the greatest dry matter weight on the soil fertilized with nitrogen and potassium (NP variant). At *KG 100* and *Studenica* sorts, the largest dry matter weight was measured on the variant fertilized with nitrogen only (N variant), while *KG 56* cultivar had maximal leaf weight on the complete fertilized soil (NPK variant). Measured dry matter was at all the sorts between 0.04 and 0.15 g (Fig. 3). On the unfertilized soil dry matter weight of leaf was the smallest at all the sorts.

Many investigations showed that there were specific sorts toward dry matter weight. It is confirmed in present experiment. On the same fertilization variant, different sorts had a different dry matter weight. Dry matter weight was increased with applied nitrogen fertilizers because nitrogen uptake is better with by adding nitrogen in the soil (D e l d e n, 2001). Besides the fertilization, a great influence on dry matter weight could have environment conditions (F r i t s c h i et al. 2003).

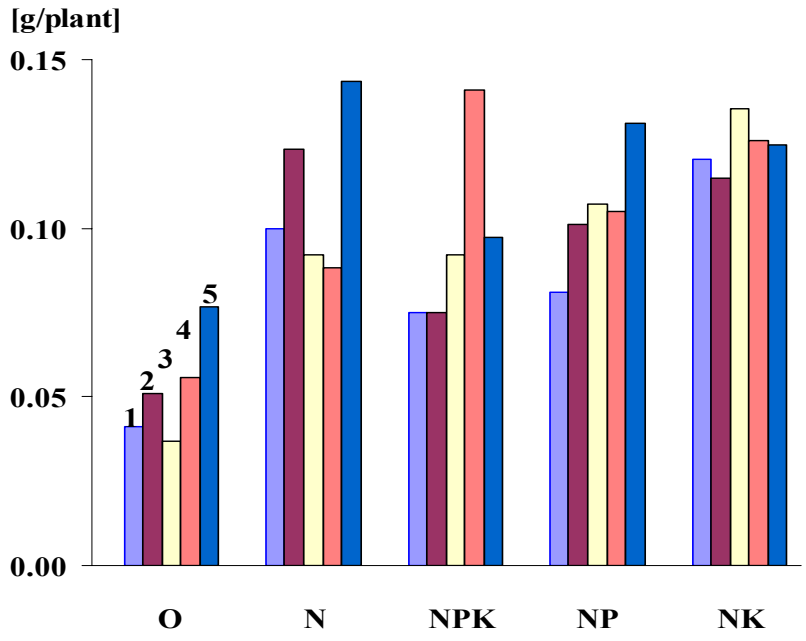

Figure 3. Dry matter weight of leaves in dependence of fertilization
Cultivar designation as in Fig. 2.

CONCLUSION

Results of examination showed that examination characteristics of wheat leaves are depended from application of mineral fertilizers. The smallest values for all the leaf characteristics were measured on unfertilized soil, and the greatest, for different cultivars on the different fertilization variants.

For the chlorophyll content, the most favorable were NP and N fertilization variants. Carotenoids content showed little variations in dependence of fertilization. The greatest influence on the leaf surface had NK and N fertilization variants. On the dry matter weight leaves NP and N variants were the most effective.

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