Research Regarding the Influence of Folliar Fertilization on Plant Assimilation, Grain Yield and Quality of Wheat, in the Transylvanian Field Conditions

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Bulletin UASVM series Agriculture 76(1) / 2019
Print ISSN 1843-5246; Electronic ISSN 1843-5386
DOI:10.15835/buasvmcn-agr: 2019.0001

Abstract

The researches were carried out during the 2016-2017 vegetation period using the wheat variety Andrada and the perspective line T. 123-11 created at ARDS Turda, which were treated with 3 types of foliar fertilizers: Folimax Gold (V2 -2 treatments, V3-3 treatments) Folimax Oleo (V4-2 treatments and V5-3 treatments) and Microfert U (V6-3 treatments) applied in two and three treatments in different phenophases of crop development. The measurements on the assimilation (An = µmol CO2 m-2s-1) and leaf evapotranspiration (Evap- mmol H2O m-2s-1) were performed on a stindard leaf, 5 days after the last foliar fertilizer treatment in June, for each variant, from the 3 reps. The application of nitrogen foliar fertilizers resulted in the increase of the leaf surface, the nitrogen content of the leaves, increasing net assimilation for all variants, evapotranspiration and production. Andrada wheat variety advanced a higher oscillation of net assimilation (An) (from 28.5-32.7 µmol CO2m-2s-1), higher evapotranspiration (Evap) (1.97-2.33 mmol H2O m-2s-1) and the production was over 7300 kg/ha in foliar fertilized variants in all three vegetation phenophases. The perspective line T. 123-11 recorded slightly lower assimilation values (An) than Andrada wheat, being more clustered (from 30-31.7 µmol CO2 m-2s-1) and evapotranspiration (1.60-1.90 mmol of H2O m-2s-1) and also productions of more than 8100 kg/ha in 3 foliar fertilization variants, using the foliar fertilizer more efficiently and water in tissues. The highest quality indices were obtained with 3 foliar fertilization variants, obtaining values between 10.9 and 11.3% for proteins, for gluten between 21.3 and 21.6% and for the Zeleny 30.8 and 34.1% for Andrada lower than T. 123-11 with protein values between 11.7 and 14.0 % and gluten content of 23.4 and 28.3%, respectively the Zeleny index from 40.0 to 54.4%.

Keywords: foliar fertilizer, quality indices, photosynthesis, production, soybean

Introduction

Wheat is one of the oldest cultivated plants being one of the most adaptable crop plants, at various environmental conditions, with a very wide ecological plasticity to pedo-climatic conditions, occupying the largest agricultural area (Bradshaw, 2016) and benefiting from efficient biological mechanisms in adaptation to soil conditions (Stoian *et al*., 2015). In severe drought conditions, photosynthetic function is significantly decreased, mostly due to the deterioration of the photosynthetic device (Petcu *et al*., 2007), but when the drought was not for a long period of time, even with reduced water reserves in the soil, by applying foliar fertilization it is possible to trigger mechanisms for adapting and avoiding

Table 1. Foliar fertilizers used on winter wheat crop

Var	Trade name, content Dose kg, l / ha	Dose kg, l/ha /250 l of water
1.	FOLIMAX Gold Aminopower-27%N, +1.5% MgO + 1.0%Mn +0,13% Cu+0,02%Zn, B, Fe:Fertinova prod. UE	3.0 l/ha with phytosanitary treatment
2.	FOLIMAX Oleo NPK+micro (12-4-24 + 2%MgO +36%SO_3, TE), Fertinova, prod. UE	2.5kg/ha with phytosanitary treatment
3.	MICROFERT U- NPK -90:30:30g/l +Mg+S,B,Co,Cu,Fe, Mn,Mo, Zn Alchimex S.A Bucuresti, Romania.	2.5 l/ha. with phytosanitary treatment

dehydration of the tissues. Choosing correctly the varieties, depending on the area and pedoclimatic conditions associated with the applied technology are decisive factors for a successful wheat crop, both productively and quantitatively (Racz *et al*., 2016). Plant breath is one of the main links in the carbon circuit through which plant-bound CO_2 returns to the atmosphere (Delian Elena, 2007, Burzo *et al*., 1999, Heller *et al*., 1991). At maturity, wheat, mostly produces photosynthesis on the stindard leaf and stalk, which is the main source of grain assimilation during grain filling (Rawson, *et al*., 1976). Applying foliar fertilizer treatments to wheat crops is essential for increasing assimilation (An) and plant growth as plant mass, quality and production. Biostimulants, including amino acids, perform a major role in many physiological processes throughout the crop life cycle from seed germination to plant maturity (Calvo *et al*. 2014). Micronutrients are required for optimum crop production and the term micronutrient refers to the relative quantities required for plant growth and does not mean that they are any less important to plants than other nutrients. Wheat growth and development may be retarded if any one of these elements is lacking in the soil or if a nutrient is not adequately balanced with other nutrients. Plants are sessile organisms that have to cope with a permanently fluctuating environment, both in space and time, and this includes changes in abiotic factors such as light, temperature, water and nutrient availabilities that are tightly linked to biotic interactions with other plants or rhizosphere microorganisms such as bacteria and fungi (Etienne *et al*., 2018).

In order to optimize the fertilization strategies, the foliar application with different types of micro and macro elements has a positive effect on plant physiological parameters and crop yields and reduces soil pollution (Rawashdeh and Sala, 2014). Using more efficient foliar fertilizer and water in tissues, in wheat experiments with foliar fertilizer, Richards (2000) observed that in net assimilation higher values are obtained, more carbon is removed per time unit. The main purpose of the research was to identify the important physiological segments in the production to improve the quality of production, for wheat variety Andrada and the T. 123-11 perspective line. For calibration and the formation of active growth intervals correlated with the productivity elements an important role is played by foliar fertilizers. The identification of physiological mechanisms regarding the wheat and their promotion has been useful in assessing the biological development of the autumn wheat.

Materials and Methods

The studies were carried out between 2016 and 2017 using the winter wheat variety Andrada as a biological material and the T. 123-11 perpective line created at ARDS Turda, very productive, with high quality indeces, which proved to be resistant to drought and high temperatures. The experiments were carried out on a neutral pH clay soil with a humus content of 0-30 cm, between 3.12 and 2.14%, and clay between 51.8-55.5% (clayey texture), the precursor plant being soybean. Basic fertilization was performed on a 40 kg/ha nitrogen and phosphorus assured background, simultaneously with the sowing (N20: P20: K0 -200 kg/ha) and application of ammonium nitrate - 60 kg/ha N s.a., in the spring at the resumption of vegetation.

Stages of application of foliar fertilizers: - straw extension, 3-4 internodes;

- the appearance of the bellows - the beginning of the spanking;
- grain filling period.

The experience was of the monofactorial type with 6 experimental variants x 3 repetitions:

- V_1 - basic fertilization without foliar fertilization (control);

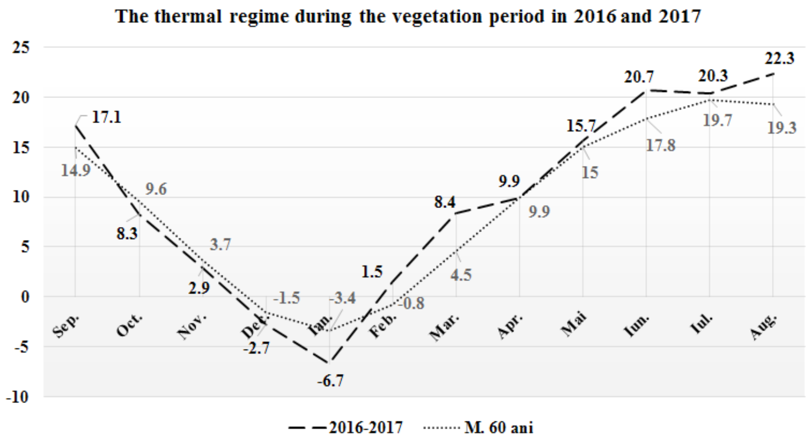

Figure 1. The monthly temperatures recorded at ARDS Turda, during 2016-2017

- V_2 - basic fertilization + 2 treatments of Folimax Gold;
- V_3 - basic fertilization + 3 treatments with Folimax Gold;
- V_4 - basic fertilization + 2 treatments with Folimax Oleo;
- V_5 - basic fertilization + 3 treatments with Folimax Oleo;
- V_6 - basic fertilization + 3 treatments with Microfert U.

Measurements of physiological parameters were carried out on the leaf after the last foliar fertilizer treatment in June by 5 readings per 5 wheat plants, each variant in 3 repetitions, and for the analysis, net photosynthesis was chosen and evapotranspiration. The research method used was based on the use of the CIRAS-3 Portable Photosynthesis System, of which the afor mentioned physiological and environmental indicators (PP System USA, - 2014) were selected. The data analysis was performed with the Statsoft Statistica v10 software (Statsoft Inc., 2012).

The statistical analysis was exploratory, related to descriptive statistics of data, correlations between experimental parameters and observations, and multiple comparisons (Fisher LSD) which were meant to evaluate the fertilization effect on the biological development of plants, separately on varieties. The quality indices were made using the INFRAMATIC 9500 NIR analyzer. Regarding the thermal regime in the wheat crop period from 1 September 2016 to the end of July 2017 it is observed that the average monthly temperatures during the vegetation period were exceeded by +2.0 °C, much higher than the multiannual averages from the last 60 years, the oscillation from one month to another was different. In February, March, April and June, exceeding the multiannual average by more than 2.0 ºC, May and July being normal to the multiannual average, a good development of the culture to form the straw appeared, even if June was drought, the growth and filling of the grains was normal (Figure 1).

Between 1st of September 2016 and 31st of July 2017, almost 659.6 mm of precipitation fell, 135.9 mm above the normal multiannual value, being characterized as a very rainy year, the heat regime being characterized as normal. The rainfall quantities during the vegetation period were much higher than the multiannual average and even if they were in excess they compensated for the temperatures and provided sufficient water in the soil, leading to a good development of the culture in the growth, development and accumulation phases (Figure 2). Climatic conditions in autumn 2016-2017 were generally oscillating, from month to month, from overly rainy to excessively dry; in this situation, for the establishment of autumn wheat crops, the amount of precipitation made difficult the soil preparation and sowing. The winter conditions in terms of temperatures were mild and did not significantly affect the density of crops, even if they were not protected by a layer of snow. At the beginning of spring, in terms of precipitation, these were balanced,also the warm weather and the lack of water in the soil, caused a slow development of the wheat vegetation. The months of April, May, June and July continued with normal temperatures in the midst of a prolonged rainfall, which made the rapid development of

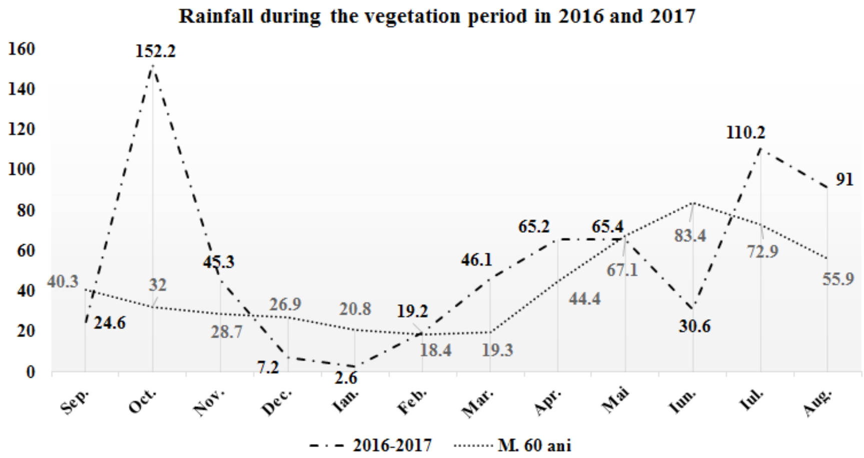

Figure 2. The monthly rainfall recorded at ARDS Turda, during 2016-2017

Table 2. Test F for Physiological Quality and Production Indicators

	F	p
Assimilation (μmolm^{-2}s^{-1})	1.89	0.093
Evapotranspiration- (mmolm^{-2}s^{-1})	2.93	0.013
Grain yield (kg/ha)	30.42	p<0.001
TKW (g)	5.45	p<0.001
Protein (%)	7.90	p<0.001
Gluten (%)	7.87	p<0.001
Zeleny Indices (ml)	9.98	p<0.001

Marked effects are significant at p < 0.05

wheat and the development of phenophases to be accelerated.

Under these circumstances, the spice formation was performed normally. In the process of stretching the straw, normal internodes were formed, which reflected in the high normal plant size, high biomass, and finally resulted in normal production.

The characterization of the thermal and pluviometric regime for the wheat culture in the period 2016-2017, was based on the primary data recorded by the Turda Meteorological Station (Figures 1 and 2).

Results and Discussions

Sample F shows that the net assimilation and evapotranspiration were influenced by the environmental conditions and the application of foliar fertilizers, the differences being statistically significantly positive, as well as the production of TKW, protein content, wet gluten content and Zeleny index.

Statistically insured values were significantly positive (Tab. 2).

Comparing the values of the yields obtained on Andrada wheat variety and T.123-11 perspective line in the 2016-2017 vegetation year, the variants treated with Folimax Gold Aminopower, Folimax Ole and Microfert U overwhelmed the different fertilizers, surpassed the control (fertilization of base) being statistically assured as being significantly positive and very significant positive. For Andrada variety, the application of foliar fertilization led to a production of more than 7000 kg/ha, the differences being statistically assured as being very significantly positive for variants V_3 and V_5 and significantly positive on variant V_6 compared to the control which was only treated with the basic fertilization.The highest yield was obtained by using Folimax Oleo foliar fertilizer, with a production growth of more than 910 kg/ha compared to the control treated only with basic fertilization (Tab. 3).

At T.123-11 perspective line, the highest yields were also obtained in the cases treated with 3 foliar fertilizer treatments, the variants V_3, V_5 and V_6 being statistically insured as being very significantly positive towards the control. The highest yields were achieved by using the

Table 3. Influence of foliar fertilizers on the grain yield of the two wheat varieties

Year	Var	Andrada	V_1	V_2	V_3	V_4	V_5	V_6
2017		Yield (kg/ha)	6400	6710	7280	6740	7310	6800
	V_1	6400		0.081	p<0.001	0.058	p< 0.001	0.028
	V_2	6710			0.003	0.870	0.002	0.610
	V_3	7280				0.004	0.862	0.010
	V_4	6740					0.003	0.729
	V_5	7310						0.006
	V_6	6800						
year	Var	Linia – T 123-11	V_1	V_2	V_3	V_4	V_5	V_6
2017		Yield (kg/ha)	6740	7890	8120	7950	8300	7960
	V_1	6740		p< 0.001	p< 0.001	p< 0.001	p< 0.001	p< 0.001
	V_2	7890			0.179	0.714	0.024	0.672
	V_3	8120				0.321	0.315	0.349
	V_4	7950					0.053	0.954
	V_5	8300						0.059
	V_6	7960						
year	Var	And.+L.T 123	V_1	V_2	V_3	V_4	V_5	V_6
2016/ 2017		Yield (kg/ha)	6400	6710	7280	6740	7310	6800
	V_1	6740	0.060	0.885	p<0.004	0.985	p< 0.001	0.714
	V_2	7890	p< 0.001	p< 0.001	p< 0.001	p< 0.001	p< 0.001	p< 0.001
	V_3	8120	p< 0.001	p< 0.001	p< 0.001	p< 0.001	p< 0.001	p< 0.001
	V_4	7950	p< 0.001	p< 0.001	p< 0.001	p< 0.001	p< 0.001	p< 0.001
	V_5	8300	p< 0.001	p< 0.001	p< 0.001	p< 0.001	p< 0.001	p< 0.001
	V_6	7960	p< 0.001	p< 0.001	p< 0.001	p< 0.001	p< 0.001	p< 0.001

values marked with red are significant: *p<0.05 *; p<0.01 **; p<0.001 ****

foliar fertilizers Folimax Oleo and Folimax Gold, which led to a grain yield rate over 22% and 20% respectively. If we take into account the control variant between the Andrada wheat variety and the T. 123-11 line, where only basic fertilization was applied, we can see that the production was higher at the T. 123-11 line with over 4%, this difference being due to a better adaptation to the oscillating climatic conditions from 2017 and better assimilation of foliar fertilizers.

Comparing the net photosynthesis of the Andrada wheat variety and the conserved T.123-11 perspective line in the 2016-2017 vegetation year, can notice that it was influenced both by environmental conditions and by the application of different foliar fertilizers. The highest net assimilation (An) was recorded by Andrada which had values from 27.1 µmol CO_2 $m^{-2}s^{-1}$ at control V_1 up to 32.8 µmol CO_2 $m^{-2}s^{-1}$ at variant V_5, treated with 3 foliar fertilizations , these being statistically assured as distinctly significantly positive for the control. Between the control variant and the variants treated with different foliar fertilizers, at the T.123-11 perspective line, net assimilation ranged between 27.9 to 31.7 µmol CO_2 $m^{-2}s^{-1}$. The highest net assimilation values were recorded using the Folimax Oleo foliar fertilizer, at V_5 variants of both varieties where 3 foliar fertilizations were applied, besides the basic fertilization, the assimilation value exceeding 31.5 µmol CO_2 $m^{-2}s^{-1}$ (Table 4). Analyzing the net photosynthesis (An) in 2017, Andrada wheat variety and the T.123-11 perspective line, the highest values were obtained by applying the three foliar fertilizers, the average assimilation values being over 30,0 µmol CO_2 $m^{-2}s^{-1}$ to V_3, V_5 and V_6 variants being statistically significantly positive positive for the control (Tab. 4).

The rate of these processes and of photosynthesis was promoted by additional nitrogen; so high rates of starch and protein accumulation by the grains were possible.

For Andrada variety and the T.123-11 perspective line, in the 2016-2017 vegetation year, evapotranspiration (Ev) was influenced by both environmental conditions and foliar fertilizers

Table 4. Influence of foliar fertilizers on net assimilation (An) of the two wheat varieties

year	Var	Andrada	V_1	V_2	V_3	V_4	V_5	V_6
2017		Net assimilation ($\mu mol\ CO_2\ m^{-2}s^{-1}$)	27.1	29.6	30.2	28.5	32.8	32.7
	V_1	27.1		0.177	0.098	0.460	0.005	0.005
	V_2	29.6			0.745	0.528	0.095	0.109
	V_3	30.2				0.342	0.171	0.194
	V_4	28.5					0.026	0.032
	V_5	32.8						0.942
	V_6	32.7						
year	Var	Linia – T 123-11	V_1	V_2	V_3	V_4	V_5	V_6
2017		Net assimilation ($\mu mol\ CO_2\ m^{-2}s^{-1}$)	27.9	30.8	31.2	30.1	31.7	30.0
	V_1	27.9		0.133	0.085	0.239	0.049	0.271
	V_2	30.8			0.814	0.731	0.613	0.672
	V_3	31.2				0.563	0.786	0.511
	V_4	30.1					0.398	0.936
	V_5	31.7						0.356
	V_6	30.0						
year	Var	And.+L.T 123	V_1	V_2	V_3	V_4	V_5	V_6
2016/ 2017		Net assimilation ($\mu mol\ CO_2\ m^{-2}s^{-1}$)	27.1	29.6	30.2	28.5	32.8	32.7
	V_1	27.9	0.664	0.351	0.212	0.758	0.013	0.015
	V_2	30.8	0.057	0.551	0.786	0.225	0.267	0.229
	V_3	31.2	0.035	0.408	0.613	0.151	0.379	0.418
	V_4	30.1	0.112	0.800	0.942	0.379	0.151	0.171
	V_5	31.7	0.019	0.275	0.439	0.092	0.539	0.588
	V_6	30.0	0.130	0.862	0.879	0.422	0.131	0.149

values marked with red are significant*: $p<0.05$ *; $p<0.01$ **; $p<0.001$ ****

Folimax Gold Aminopower, Folimax Oleo and Microfert U. In general Evapotranspiration (Ev) in the Andrada variety had values close to the control, with the exception of variant V_3 which had 2.33 mmol $H_2O\ m^{-2}s^{-1}$ that exceeded the control, being statistically significantly positive. Between the untreated variant and the variants treated with the various foliar fertilizers, wheat culture of the Andrada variety, the evapotranspiration (Ev) had values from 1.97 to 2.33 mmol $H_2O\ m^{-2}s^{-1}$, there being no statistical differences between the variants and control variant.

On the T-123-11 prospective line, also in the V_3 variant, evapotranspiration (Evap) was higher, as the control, the rest of the variants obtaining less or equal values which did not statistically differ from the control. Between the wheat variety Andrada and the line T.123-11, in the 2016-2017 vegetation year, evapotranspiration (Ev) was higher for the Andrada variety, influenced both by environmental conditions and by applying different foliar fertilizers, Folimax Gold, Folimax Oleo and Microfert U, the highest evapotranspiration differences (Evap) were on variants V_2 and V_3 (Tab. 5).

From the grain yield graph can be noticed that the Andrada wheat variety has a particular constancy in the application of foliar fertilization, besides the basic fertilization, with increasing production the assimilation increases (Figure 4). From the assimilation chart can see that the wheat variety Andrada, and the line T.123-11 had an uprise of the production from 6700 kg/ha to over 8000 kg/ha with increasing the assimilation which led to a higher stability in the range 28 to 32 μmol $CO_2\ m^{-2}s^{-1}$ due to the applied fertilization levels of different types of foliar fertilizers, Folimax Gold Aminopower, Folimax Oleo and Microfert U and the pedoclimatic conditions of the area (Figure 3). Assimilation does not restrict plant production potential due to nitrogen in fertilizer composition and microelements, stimulating vigorous plant development, crop production and quality (Natr, 1975).

From the evapotranspiration chart, there can be seen that in the Andrada variety and line T.123-11, once with the growth of the production,

Table 5. Influence of foliar fertilizers on evapotranspiration. (Ev- mmolm^{-2}s^{-1}) of the two wheat varieties

year	Var	Andrada	V_1	V_2	V_3	V_4	V_5	V_6
2017		Evapotrans. (mmol H_2O m^{-2}s^{-1})	2.17	2.16	2.33	1.97	2.08	2.15
	V_1	2.17		0.985	0.336	0.276	0.648	0.954
	V_2	2.16			0.327	0.284	0.662	0.970
	V_3	2.33				0.047	0.162	0.309
	V_4	1.97					0.519	0.301
	V_5	2.08						0.690
	V_6	2.15						
year	Var	Line – T 123-11	V_1	V_2	V_3	V_4	V_5	V_6
2017		Evapotrans. (mmol H_2O m^{-2}s^{-1})	1.89	1.85	2.15	1.75	1.60	1.90
	V_1	1.89		0.710	0.157	0.427	0.100	0.954
	V_2	1.85			0.096	0.595	0.162	0.746
	V_3	2.15				0.032	0.004	0.173
	V_4	1.75					0.375	0.395
	V_5	1.60						0.089
	V_6	1.90						
year	Var	And.+L.T 123	V_1	V_2	V_3	V_4	V_5	V_6
2017		Evapotrans. (mmol H_2O m^{-2}s^{-1})	2.17	2.16	2.33	1.97	2.08	2.15
	V_1	1.89	0.132	0.137	0.018	0.662	0.284	0.147
	V_2	1.85	0.080	0.083	0.010	0.483	0.185	0.089
	V_3	2.15	0.924	0.939	0.292	0.318	0.718	0.970
	V_4	1.75	0.026	0.028	0.003	0.223	0.069	0.030
	V_5	1.60	0.003	0.003	p< 0.001	0.041	0.010	0.004
	V_6	1.90	0.147	0.152	0.020	0.704	0.309	0.162

values marked with red are significant: $p<0.05$ *; $p<0.01$ **; $p<0.001$ ***

the evapotranspiration decreases, being stable in the range 1.8-2.3 mmol H_2O m^{-2}s^{-1}, although at large productions there are no increases of the evapotranspiration. Higher seasonal temperatures shorten the duration of the phenophases, resulting in less time for biomass accumulation, reducing evapotranspiration and the use of water available to fill wheat grains, thus avoiding higher summer temperatures over 34 °C (Senthold *et al*., 2011)

In wheat variety Andrada, evapotranspiration is higher and constant at the application of fertilization levels ranging between 2.00 to 2.33 mmolm^{-2}s^{-1} compared to line T. 123-11, which decreases at the application of fertilization levels 1,85- 2,10 mmol H_2O m^{-2}s^{-1} and production increases.

The quality of wheat variety is determined by the genetic potential of each genotype, its ability to adapt and interact with the environment and the specific production potential (Ceclan *et al*., 2015, Fowler *et al*., 1990). The same variety can work differently on another type of soil and rainfall regime. The winter wheat variety Andrada maintains its high TKW both under favorable and unfavorable environmental conditions (Racz *et al*., 2014), being used as a control for this trait, the values obtained are higher and more balanced 45.0-46.5g in the foliar fertilized variants, compared to the T. 123-11 line, where the values obtained were more oscillating, at the 6 variants used in the experiment, ranging from 42.6 to 46.1g, differences being statistically assured as significantly negative, compared to the control variant.

Analizing the quality indices for Andrada variety used as a control, the values obtained allow to include this variety among those of de good, and very good quality (Moldovan *et al*.,

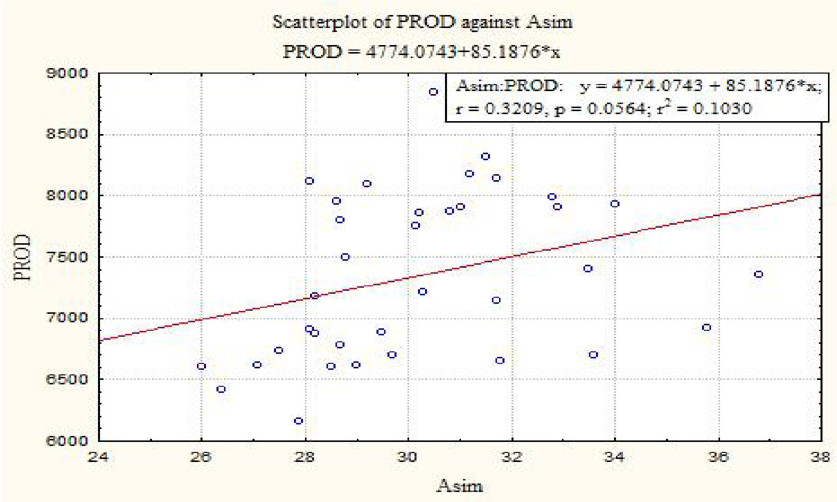

Figure 3. Multiple interaction between assimilation (An) and production.

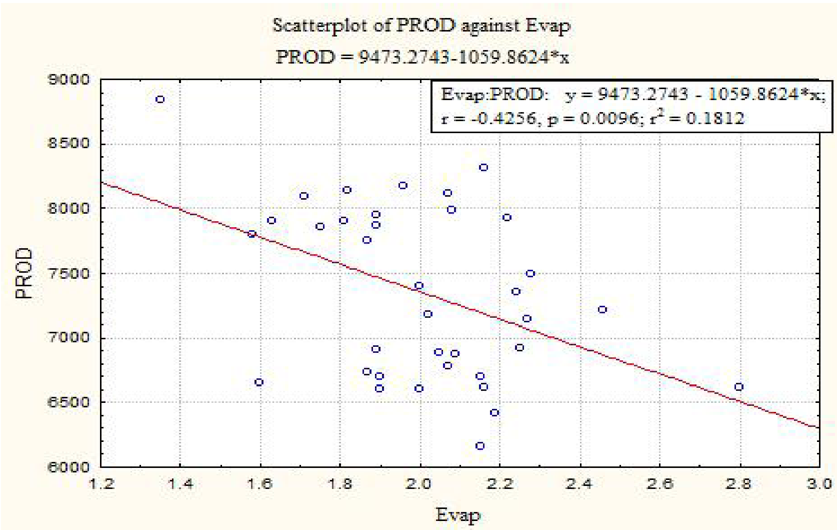

Figure 4. Multiple interaction between evapotranspiration (Ev) and production.

2012) to protein ranging between 10.5 to 11.6%. At the T.123-11 line at the 6 variants (V_1-V_6), the percentage of protein oscillated from 11.4 to 14%, recording differences statistically assured as significant and very significantly positive versus control variant.The percentage of gluten at the T.123-11 line was higher in all variants from 22.2 to 28.3% showing differences statistically ensured as significant and significantly positive for the wheat variety Andrada, which had lower values from 20.2 to 21.6%. Regarding the Zeleny index, T.123-11 line obtained higher values on all fertilized variants, from 38.2 to 54.4 showing very significantly positive differences from the control, which obtained values from 30.3 to 34 ,1.

Conclusions

Through the application of foliar fertilizers the grain yield increases in Andrada variety were between 910 kg/ha in the base fertilization version + 3 folimax Oleo treatments and 880 kg/ha in the basic fertilization solution + 3 treatments with Folimax Gold .

The perspective line T. 123-11, Folimax Oleo and Folimax Gold foliar fertilizers were above 1500 kg/ha and 1350 kg/ha respectively.

The influence of application of foliar fertilizers on the wheat variety Andrada and T. 123-11 line has resulted an increased photosynthesis intensity, production, leaf size development, an extension of the vegetation period and carbohydrate assimilation, increased quality indices and biomass.

Table 6. Quality indices Andrada wheat varieties and a conserved T.123-11 perspective line, fertilized with foliar fertilizer

Variant	TKW		%		Difference		Significance	
fertilizer / variety	Andrada	T 123	Andrada	T 123	Andrada	T 123	Andrada	T 123
V_1- control	45.8	42.6	100.0	93.1	0.00	-3.17	Mt.	000
V_2-BF+2 trat. F Gold	46.5	46.1	100.0	99.2	0.00	-0.37	Mt.	-
V_3- BF+3trat. F Gold	44.9	43.5	100.0	96.7	0.00	-1.47	Mt.	00
V_4- BF+2 trat. F Oleo	45.4	42.9	100.0	94.6	0.00	-2.47	Mt.	000
V_5- BF+3 trat. F Oleo	45.2	42.7	100.0	94.5	0.00	-2.50	Mt.	000
V_6- BF+3 trat. Microfert	45.0	43.2	100.0	95.9	0.00	-1.83	Mt.	000
	LSD (p 5%) 0.79; LSD (p 1%) 1.10; LSD (p 0.1%) 1.56.							
Variant	Protein		%		Difference		Significance	
fertilizer / variety	Andrada	T 123	Andrada	T 123	Andrada	T 123	Andrada	T 123
V_1- control	11.3	12.1	100.0	108.4	0.00	0.93	Mt.	**
V_2-BF+2 trat. F Gold	10.5	14.0	100.0	133.7	0.00	3.53	Mt.	***
V_3- BF+3trat. F Gold	11.1	11.6	100.0	104.5	0.00	0.50	Mt.	*
V_4- BF+2 trat. F Oleo	10.6	11.4	100.0	108.2	0.00	0.87	Mt.	**
V_5- BF+3 trat. F Oleo	10.9	11.8	100.0	108.2	0.00	0.90	Mt.	**
V_6- BF+3 trat. Microfert	10.7	11.9	100.0	111.5	0.00	1.23	Mt.	***
	LSD (p 5%) 0.47; LSD (p 1%) 0.67; LSD (p 0.1%) 0.94.							
Variant	Gluten		%		Difference		Significance	
fertilizer / variety	Andrada	T 123	Andrada	T 123	Andrada	T 123	Andrada	T 123
V_1- control	21.6	23.8	100.0	110.2	0.00	2.20	Mt.	***
V_2-BF+2 trat. F Gold	20.2	28.3	100.0	139.9	0.00	8.07	Mt.	***
V_3- BF+3trat. F Gold	21.6	22.6	100.0	104,9	0.00	1.07	Mt.	*
V_4- BF+2 trat. F Oleo	20.4	22.4	100.0	109.6	0.00	1.97	Mt.	***
V_5- BF+3 trat. F Oleo	21.3	23.5	100.0	110.2	0.00	2.17	Mt.	***
V_6- BF+3 trat. Microfert	21.6	23.4	100.0	108.3	0.00	1. 80	Mt.	**
	LSD (p 5%) 0.93; LSD (p 1%) 1.31; LSD (p 0.1%) 1.85							
Variant	Zeleny index		%		Difference		Significance	
fertilizer / variety	Andrada	T 123	Andrada	T 123	Andrada	T 123	Andrada	T 123
V_1- control variant	34.1	42.6	100.0	124.9	0.00	8.50	Mt.	***
V_2-BF+2 trat. F Gold	30.3	54.4	100.0	179.5	0.00	24.10	Mt.	***
V_3- BF+3trat. F Gold	33.8	38.3	100.0	113.5	0.00	4.57	Mt.	***
V_4- BF+2 trat. F Oleo	31.2	38.6	100.0	123.6	0.00	7.37	Mt.	***
V_5- BF+3 trat. F Oleo	32,9	40.9	100.0	124.5	0.00	8.07	Mt.	***
V_6- BF+3 trat. Microfert	30.8	40.7	100.0	132.1	0.00	9.90	Mt.	***
	LSD (p 5%) 0.73 LSD (p 1%) 1.03 LSD (p 0.1%) 1.47.							

The results of the average values obtained show that the additional fertilization provides a production growth as well as an increase in the average values of the other production components or qualitative indices, also giving a smaller variation of the values of these characters.

Acknowledgements: This work was supported by a grand of the Romanian Ministry of Research and Innovation, CCCDI-UEFISCDI, Project number PN –III-P1-1.2-PCCDI-2017-0056, within PNCDI III.

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