RESEARCHES REGARDING THE INFLUENCE OF CROP ROTATION (FORERUNNER PLANT) AND FERTILIZATION LEVEL ON THE DYNAMICS OF TOTAL DRY BIOMASS ACCUMULATION IN WINTER WHEAT

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Abstract. The knowledge of biomass accumulation dynamics in winter wheat, correlated to concrete edaphic and climatic conditions, race and cultivation technologies, offers the possibility of guiding the process toward the realization of higher and stable production efficiency per surface unit.

Research and production results were engaged at the elaboration of the present work, and especially the original researches developed by the author referring to the biomass accumulation dynamics in winter wheat cultivated on brown-luvic soils in central area of the Western Plain of Romania. Data from scientific literature were also used in the present work.

The theoretical and practical importance as compared to other similar works is enhanced by a strict reference to a particular area in western Romania.

The present work is bringing new information to the actual scientific area of interest and offers technical solutions for efficient technical interventions in correlation with biological capacity of the plant putting them in value.

Keywords: forerunner plant, fertilization level, biomass accumulation, phenophase, winter wheat.

INTRODUCTION

Researches led in our country and abroad, streched the outmost influence of such factors as: vegetation, soil and cultivation technologies on the biomass accumulation in winter wheat.

The synthesis of various conclussions formulated by different authors (risks included as in any synthetical approach), refers to the importance of the knowledge on biomass accumulation influenced by crop rotation, fertilization, underlining influencial factors [1].

Understanding the importance of the biomass accumulation dynamics in winter wheat was streched by different authors [6]. The undelying conclussions are presented next.

Most of the reserches led in Romania, were centrated on the influence of the crop rotation on yields,namely on biomass accumulation and produced an hierarchical ordination of crop rotations with regard to wheat from very beneficial to satisfactory in this order: pea, beans, winter rape, bots, linseed, soja, red clover, potato, sugar beet, sunflower, corn, etc.

After long run tests Bilteanu (1993) [3] demonstrated the importance of crop rotation on wheat yields on brown-red soils in Romanian Plain.

On clay-illuvial podzols, the intromission of ameliorative plants such as red clover represented an element of outmost importance for wheat yield increase.

Dinca (1982) [4] made some references on the role of crop rotation on wheat yield, respectively on organic accumulation in whole plant and grains. It is demonstrated that after 10-years of monoculture, wheat yield decreases continuously as compared to crop rotations. It fluctuates, as a consequence of the changing climatic conditions. Under such circumstances, fertilization does not induce a significant yield increase.

Wheat even in a simple crop rotation such as wheat-corn rotation valorizes economically even moderate doses of fertilizers. The introduction of an ameliorative plant such as pea or soy raises significantly economic efficiency of applied fertilizers. As several authors notice, a moderate fertilization in a crop rotation system influences positively not only biomass accumulation in the whole plant and grains, but also the biological quality of wheat yields [7].

A particularly important problem is linked to wheat crop increment, which must fit the rising consumption needs of world population [8].

The author presents a synthesis of researches developed in Romania, emphasizing the positive correlation between plant's growth, biomass accumulation and climatic evolutions within cultivated areas of Romania.

The complex influence of crop rotation is in relation with the fertilization. Ionescu (1985) [5] remarked that on acid soils, the fertilizers' effect was greater in crop rotation as compared to monocultures characterized by a low biomass accumulation correspondingly, a low yield.

Advances in biomass accumulation dynamics in winter wheat pedo-climatic conditions of Western Plain of Romania were made by Zăhan P. and Zăhan R. (1989a,b) [9, 10] during the studies on Transylvanian wheat race.

The influence of each of the studied factors on dry biomass accumulation in wheat shows that crop rotation and fertilization determines essential differences in what concerns the accumulation of dry biomass.

In respect to the influence of fertilization on biomass accumulation in winter wheat, frequent researches put in a direct relationship the biomass accumulation and utilized fertilizers [2].

MATERIALS AND METHODS

The researches were set at Agricultural Research and Development Center (A.R.D.C) Oradea (Romania), between 2003-2006, on soils characterized by temporary excess of humidity as brown luvic soils (acid soils), that are having the realization of total biomass in function to the (crop rotation) forerunner plant, fertilization level and phenophase. The experimental design was polyfactorial in subdivided stands using as interaction factors: forerunner plant, fertilization level and phenophase. As biological material, the Dropia race of wheat was engaged.

Experimental results (biomass accumulation) were analyzed by ANOVA methods (analysis of variance) and expressed as g of dry weight/10 plants.

RESULTS

In the following excerpt we present the results of the experiments, concerning the influence of crop rotation plant and fertilization level on the total dry biomass accumulation dynamics in winter wheat (Table 1) and the influence of crop rotation plant, fertilization level and phenophase on the total dry biomass accumulation dynamics in winter wheat (Table 2).

Table 1. The influence of crop rotation plant and fertilization level on the total dry biomass accumulation dynamics in winter wheat (Oradea, Romania, 2003-2006)

Investigated factor	Quantity of dry biomass (g. d.w./10 plants)							
	Total dry biomass, of which			Grain			Straw	%
	g	Difference ±	Significance	g	Difference ±	Significance	g	
a. Crop rotation								
Wheat monoculture (Mt)	19.69	N/A	N/A	12.55	N/A	N/A	7.14	N/A
Corn (W-C)	21.07	+1.38	***	14.01	+1.46	**	7.06	N/A
Pea (P-W-C)	23.29	+3.60	***	17.18	+4.36	***	6.11	N/A
Pea (P-W-C-C)	24.79	+5.10	***	17.87	+5.32	***	6.92	N/A
DL 5 % DL 1 % DL 0.1 %	N/A	0.139 0.115 0.292	N/A	N/A	2.27 3.28 4.80	N/A	N/A	N/A
b. Fertilization level								
N_0P_0 (Mt)	18.07	N/A	N/A	11.54	N/A	N/A	6.53	N/A
$N_{120}P_{80}$	23.32	+5.15	***	16.62	+5.08	***	6.60	N/A
$N_{100}P_{80}$ + 10 t/ha manure	25.36	+7.29	***	18.54	+7.00	***	6.82	N/A
DL 5 % DL 1 % DL 0.1 %	N/A	0.050 0.070 0.093	N/A	N/A	0.92 1.35 2.27	N/A	N/A	N/A

Statistical significations:
- for *Total dry biomass*: under 0.050 = insignificant (-); 0.050-0.070 = significant (*); 0.070-0.093 = distinct significant (**); over 0.093 = very significant (***);
- for *Grain*: under 0.92 = insignificant (-); 0.92-1.35 = significant (*); 1.35-2.27 = distinct significant (**); over 2.27 = very significant (***).

Table 2. The influence of crop rotation plant, fertilization level and phenophase on the total dry biomass accumulation dynamics in winter wheat (Oradea, Romania, 2003-2006)

Investigated factor	Quantity of dry biomass (g. d.w./10 plants)							
	Total dry biomass, of which			Grain			Straw	%
	g	Difference ±	Significance	g	Difference ±	Significance	g	
Phenophase								
At winter's beginning	0.53	N/A	N/A	N/A	N/A	N/A	0.53	N/A
At the end of winter	0.95	+0.42	***	N/A	N/A	N/A	0.95	N/A
The beginning of vegetation	2.56	+2.03	***	N/A	N/A	N/A	2.56	N/A
The formation of the first interned	5.04	+4.51	***	N/A	N/A	N/A	5.04	N/A
Straw elongation	12.04	+11.51	***	N/A	N/A	N/A	12.04	N/A
The formation of spike	28.04	+27.87	***	N/A	N/A	N/A	28.04	N/A
Beginning of seeds formation	37.86	+37.33	***	N/A	N/A	N/A	37.86	26.4
Early ripening	42.28	+41.75	***	12.09	N/A	N/A	30.19	N/A
Incomplete ripening	45.44	+44.91	***	15.03	+2.94	***	30.41	N/A
Complete ripening	46.98	+46.45	***	19.11	+7.02	***	27.87	N/A
DL 5 % DL 1 % DL 0.1 %	N/A	0.096 0.124 0.159	N/A	N/A	1.03 1.42 1.82	N/A	N/A	N/A

Statistical significations:
- for *Total dry biomass*: under 0.096 = insignificant (-);0.009-0.124 = significant (*); 0.124-0.159 = distinct significant (**); over 0.159 = very significant (***);
- for *Grain*: under 1.03 = insignificant (-); 1.03-1.42 = significant (*); 1.42-1.82 = distinct significant (**); over 1.82 = very significant (***).

DISCUSSION

There is a positive correlation between the quality of crop rotation plant and the evolution of values found in grain biomass accumulation. Thus, as compared to wheat monoculture with an average value of 12.55 g d.w./ 10 plants, corn and pea as wheat crop rotation plants determined distinct to very significant crop increments between 1.38-5.10 g d.w./10 plants (Table 1).

Wheat cultivated after pea, registered the highest values in grain as well as in whole plant, surpassing significantly to distinctly significant the values obtained after corn (1.46-5.32 g d.w./ 10 plants).

In respect to the obtained fertilization level (see data in Table 1), was observed a positive correlation between total biomass accumulation in grains and fertilization level. As compared to unfertilized alternative in respect to the total plant biomass accumulation and grain biomass accumulation, mineral fertilization and mineral-organic fertilization determined very significant increments between 5.15-7.29 g d.w./ 10 plants and 5.08-7.00 g d.w./10 plants respectively, in grain.

The highest values were found in organic-mineral fertilization alternative (25.36 g d.w./10plants and 18.54 g d.w./10 plants).

The dynamics of biomass accumulation are expressed in Table 2. Data analysis reveal an increase in plant biomass accumulation from winter's beginning to maturity (0.53-46.98 g d.w./10 plants).

During the first part of vegetation period, the differences in accumulation are reduced (including the first internode phase), there is an important increase in values immediately after this period (beginning with straw differentiation phase) to 12.04 g d.w./10 plants (straw elongation phase). The biggest differences between phenophases were found during straw elongation phase to ear differentiation phase when there was an significant increase to a maximum of 16.36 g d.w./10 plants.

Compared to the beginning of winter phenophase in wheat (0.53 g d. w./10 plants), the increment of biomass accumulation is very significant varying between 0.42 and 46.45 g d.w./10 plants.

Concerning the grain, there is a parallel between the phenophase and biomass accumulation from 12.09 g d.w./10 plants during early spring to 19.11 g d.w./10 plants at complete ripening, including the interval from 2.94 g d.w./10 plants to 7.02 g d.w./10 plants.

Percent participation of synthesized substances before fructification in grain differentiation was of 26.4% and represented a particularly important contribution of organic mass accumulated prior to grain differentiation to realization of grain efficiency per plant.

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