RESEARCHES ON THE DYNAMICS OF FITOMASS ACCUMULATION IN WINTER WHEAT CULTIVATED ON BROWN SOILS IN THE WESTERN PLAIN OF ROMANIA

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Abstract

The knowledge of fitomass 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 employed at the elaboration of the present work, mainly original researches developed by author referring to the fitomass 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 adding new information to an actual scientific area of interest and offers technical solutions for efficient technical interventions in correlation with biological capacity of the plant to put them into value.

Key words: fitomass, fertilisation, phenophase, climatic conditions, accumulation, brown luvic

INTRODUCTION

Researches conducted in our country and abroad, expanded the outmost influence of such factors as: vegetation, soil and cultivation technologies on the biomass accumulation in winter wheat (Guş P., Bandici Gh., 2001).

The synthesis of various conclusions reached by different authors (risks included as in any synthetical approach) refers to the importance of knowledge on biomass accumulation influenced by crop rotation, fertilization and their underlining influential factors (Bandici Gh., 1997).

The importance of understanding the biomass accumulation dynamics in winter wheat was expanded by different authors. The underlying conclusions are presented next. (Lazany, J., 2000, 2003).

Most of the reserch led in Romania was focussed on the influence of crop rotation on yields (Domuta C., 2007,2008), namely on biomass accumulation, and produced a hierarchical ordination of crop rotations with regard to wheat from very beneficial to satisfactory in this order: pea, beans, winter rape, bots, linseed, soya, red clover, potato, sugar beet, sunflower, corn, etc.

Muntean et al., (2008), after long-run tests, demonstrated the importance of crop rotation on wheat yields on brown-red soils in Romanian Plain. On clay-illuvial podzols, the introduction of ameliorative plants such as red clover represented an element of outmost importance for wheat yield increase.

Hera Cr., (1986a) made some references on the role of crop rotation on wheat yield, on organic accumulation in whole plant and grains, respectively.

It is demonstrated that after 10-year monoculture, wheat yield decreases continously as compared to crop rotations. It fluctuates as a consequence of changing climatic conditions. Under such circumstances, fertilization does not induce a significant yield increase. A particularly important problem is linked to wheat crop increment, which must fit the rising consumption needs of world population (Hera, 1986b).

Oproiu E., Cernescu L., (1970) presents a synthesis of researches developed in Romania, emphasizing the positive correlation between plant growth, fitomass accumulation and climatic evolutions within cultivated areas of Romania.

The complex influence of crop rotation is in relation with fertilization. Dinca (1971) remarked that the effect of fertilizers on acid soils was greater in crop rotation as compared to monocultures characterized by a low fitomass accumulation and, correspondingly, a low yield.

Advances in biomass accumulation dynamics in winter wheat in the pedo-climatic conditions of Western Plain of Romania were made by Zăhan P. and Zăhan R. (1989) during the studies on Transylvanian wheat variety.

The influence of each factor of the studies on dry biomass accumulation in wheat shows that crop rotation and fertilization determines essential differences in what concerns the accumulation of dry fitomass (Soltner, 1990; Salisbury, Ross, 1995).

Concerning the influence of fertilization on biomass accumulation in winter wheat, frequent researches correlated the fitomass accumulation and utilized fertilizers (Bandici, Domuţa, Ardelean, 2003).

MATERIAL AND METHODS

The research was carried out at Research and Development Agricultural Station (S.C.D.A.) Oradea, between 2009 and 2011, on soils characterized by temporary excess of humidity as brown luvic soils are having the realization of total biomass as function of forerunner plant, agrofund and phenophase.

The experimental design was polyfactorial in subdivided stands using the forerunner plant, the agrofund and the phenophase as interaction factors. As biological material, the Delia variety of wheat was employed.

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

RESULTS AND 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 in corn (1.46-5.32 g d.w./ 10 plants).

Concerning the obtained agrofund (see data in table 1), we noticed a positive correlation between the total biomass accumulation in grains and the fertilization level.

As compared to an unfertilized alternative with respect to 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. Highest values were found in organic-mineral fertilization alternative (25.36 g d.w./10plants and 18.54 g d.w./10 plants).

Dynamics of biomass accumulation are expressed in table 2. Data analysis reveal an increase in plant biomass accumulation from the beginning of winter 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); however, 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 a 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. Regarding the grain, there is a parallel between the phenophase and biomass accumulation from 12.09 g d.w./10 plants during the 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. The 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 the realization of grain efficiency per plant.

Table 1

The effect of crop rotation plant and agrofund on dry fitomass accumulation dynamics in winter wheat on brown luvic soils, Oradea 2009-2011

Investigated factor	Quantity of dry biomass (g. d.w./10 plants)							
	Total dry fitomass, of which:			Grain			Straw	
	g	Difference ±	Significance	g	Difference ±	Significance	g	%
a. Crop rotation								
Wheat monoculture (Mt)	19.69	-	-	12.55	-	-	7.14	-
Corn (W-C)	21.07	+1.38	***	14.01	+1.46	**	7.06	-
Pea (P-W-C)	23.29	+3.60	***	17.18	+4.36	***	6.11	-
Pea (P-W-C-C)	24.79	+5.10	***	17.87	+5.32	***	6.92	-
DL 5 % DL 1 % DL 0,1 %		0.139 0.115 0.292			2.27 3.28 4.80			
b.Created agrofund								
N_0P_0 (Mt)	18.07	-	-	11.54	-	-	6.53	-
$N_{120}P_{80}$	23.32	+5.15	***	16.62	+5.08	***	6.60	-
$N_{100}P_{80}$ + 10 t/ha manure	25.36	+7.29	***	18.54	+7.00	***	6.82	-
DL 5 % DL 1 % DL 0,1 %		0.050 0.070 0.093			0.92 1.35 2.27			

Table 2

The effect of crop rotation plant, agrofund and phenophase on dry fitomass accumulation dynamics in winter wheat on brown luvic soils, Oradea 2009-2011

Investigated factor	Quantity of dry fitomass (g. d.w./10 plants)							
	Total dry fitomass, of which:			Grain			Straw	
	g	Difference ±	Significance	g	Difference ±	Significance	g	%
a. Phenophase								
At the beginning of winter	0.53	-	-	-	-	-	0.53	-
At the end of winter	0.95	+0.42	***	-	-	-	0.95	-
The beginning of vegetation	2.56	+2.03	***	-	-	-	2.56	-
The formation of first interned	5.04	+4.51	***	-	-	-	5.04	-
Straw elongation	12.04	+11.51	***	-	-	-	12.04	-
The formation of spike	28.04	+27.87	***	-	-	-	28.04	-
Beginning of seeds formation	37.86	+37.33	***	-	-	-	37.86	26.4
Early ripening	42.28	+41.75	***	12.09	-	-	30.19	-
Incomplete ripening	45.44	+44.91	***	15.03	+2.94	***	30.41	-
Complete ripening	46.98	+46.45	***	19.11	+7.02	***	27.87	-
DL 5 %		0.096			1.03			
DL 1 %		0.124			1.42			
DL 0,1 %		0.159			1.82			

CONCLUSIONS

During the last phenophase, the stem contributed substantially to the total biomass accumulation, being positively correlated to crop rotation plant and created agrofund. Stem weight of total biomass rose proportionally to agrofund increment, due to mineral and organo-mineral fertilization, regardless of the crop rotation plant, being more accentuated in the case of wheat monoculture and after corn as crop rotation plant respectiely after pea fertilized with mineral fertilizers. Main contribution to biomass accumulation had ear during last phenophase, regardless to crop rotation plant and agrofund, crop rotation plant and mixed fertilization, as compared to wheat monoculture.

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