RESEARCHES REGARDING THE INFLUENCE OF CROP ROTATION AND FERTILISATION LEVEL ON THE DYNAMICS OF BIOMASS ACCUMULATION IN WINTER WHEAT CULTIVATED ON THE LUVOSOILS

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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 employed at the elaboration of the present work, mainly original researches developed by author referring to the bioomass accumulation dynamics in winter wheat cultivated on luvosoils 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:crop rotation,fertilisation level, phenophase, accumulation, bioomass, luvosoils,

INTRODUCTION

Most of the reserches led in Romania, were centrated on the influence of 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. (Zamfirescu, 1977, Bîlteanu, 1993, Domuta, 2012).

Muntean and others (2011) 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.

Dinca, (1971,1982) 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 (Guş, Bandici, 2001, Ardelean, 2009, 2013).

The author presents a synthesis of researches developed in Romania, emphasizing the positive correlation between plant growth, biomass accumulation and climatic evolutions within cultivated areas of Romania (Austin, 1978, Soltner, 1990, Bandici, 1997). The complex influence of crop rotation is in relation with fertilization. Lazany, 2000, 2003, Domuta and al., 2007, 2008) 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 phytomass accumulation dynamics in winter wheat pedo-climatic conditions of Western Plain of Romania were made by Zăhan P. and Zăhan R. (1989) during the studies on Transsylvanian wheat race.

The influence of each of studies factors on dry biomass accumulation in wheat shows that crop rotation and fertilization determines essential differences in what concerns the accumulation of dry biomass (Salisbury and Ross, 1995, Bandici, 1997, Bandici and al., 2003).

MATERIAL AND METHODS

The research was set at Agrozootechnical Researches Experimental Station (A.R.D.S) Oradea (Romania), between 2012-2013, on soils characterized by temporary excess of humidity as luvosoils are having the realization of total bioomass as function of forerunner plant, agrofund and phenophase.

The experimental design was polyfactorial in subdivides stands using as factors interaction:.Crop rotation, fertilization level and phenophase. As biological material, the Delia race of wheat was employed.

Experimental results (phytomass 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 registrated 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).

Concerning the obtained fertilization level (see data in table 1), it was observed a positive correlation between total biomass accumulation in grains and fertilization level. As compared to 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).

Table 1

The effect of crop rotation plant and fertilization level on dry biomass accumulation dynamics in winter wheat cultivated on luvosoils, (Oradea, 2012-2013)

Investigated factor	Quantity of dry biomass (g. d.w./10 plants)							
	Total dry biomass, of which:			Grain			Straw g	%
	g	Difference ±	Significance	g	Difference ±	Significance		
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	-
LSD 5 % LSD 1 % LSD 0,1 %		0.139 0.115 0.292			2.27 3.28 4.80			
b.Fertilisation level								
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	-
LSD 5 % LSD 1 % LSD 0.1 %		0.050 0.070 0.093			0.92 1.35 2.27			

Statistical significations:

- for *Total dry bioomass*: 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 (***).

Dynamics of biomass accumulation are expressed in table 2. Data analysis reveal an increase in plant biomass accumulation from 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), 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). Biggest differences between phenophases was 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 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.

Table 2

The effect of phenophase on dry biomass accumulation dynamics in winter wheat cultivated on luvosoils, (Oradea, 2012-2013)

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	%
At winter beginning	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	-
LSD 5 %		0.096			1.03			
LSD1 %		0.124			1.42			
LSD 0.1 %		0.159			1.82			

Statistical significations:

- for *Total dry biomass*: under 0.096= insignificant (-); 0.096-0.124 = 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 (***).

CONCLUSIONS

During the last phenophase, stem contributed substantiall to the total biomass accumulation being positively correlated to crop rotation plant and fertilisation level. Stem wheight of total biomass raised proportionally to agrofund increment due to mineral and organo-mineral fertilization, regardless to 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.

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