RESEARCHES REGARDING THE INFLUENCE OF CLIMATIC CONDITIONS x FORERUNNER PLANT x FERTILISATION LEVEL INTERACTION ON BIOMASS ACCUMULATION IN WINTER WHEAT CULTIVATED ON BROWN LUVIC SOILS

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Abstract

The forerunner plant is a decisive factor influencing growth and development of wheat. The role of forerunner plant on wheat growth and development is stressed out by several authors: Pop L.(1967), Popescu Ana (1980), Milică C. et al. (1968), Zăhan P. and Zăhan Rodica (1969, 1989).

Plant growth is fundamental in obtaining yield and is related vegetation and technological factors, the level of yield being reflected in the intensity of biomass accumulation.

In the majority of cases, total growth of green mass is considered on the assumption that a maximum yield is obtained by increasing total dry weight biomass production and by a favourable repartition of it among plant's organs.

Key words: crop rotation, fertilization, phenophase, phytomass, forerunner plant, climatic conditions

INTRODUCTION

Bingham (1980) stressed out that the accumulation process of total green mass relies on the absorption of nutrients from soil through the plant root system. In turn, the root system depends on the level of foliar system functioning conditioned by water and nutrients' provision of soil.

Researches conducted in our country and abroad expanded the utmost influence of such factors as: vegetation, soil and cultivation technologies on the biomass accumulation in winter wheat (Austin, R., B.,1978).

The synthesis of various conclusions formulated by different authors (risks included as in any synthetical approach) refers to the importance of knowledge on biomass accumulation influenced by crop rotation, fertilization, underlining influential factors (Kramer, 1980; Schmidt, 1980; Dinca, 1982; Ionescu, 1985; Soltner, 1990; Salisbury, Ross, 1995; Bandici Gh., 1997).

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

Most of the reserches carried out in Romania were focussed on the influence of crop rotation on yields (Zahan, Zahan, 1986a, b; 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.

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

MATERIAL AND METHODS

The research was set at Research and Development Station in Oradea (S.C.D.A.) between 2010 and 2011. This period was characterized by an alternation of favourable climatic conditions during 2010 (a normal climatic year) and, respectively, less favourable, dry climatic conditions during 2011. The experimental design was polyfactorial in subdivided stands using the climatic conditions versus fertilization level as factors of interaction. The influence of later factors was studied on the dynamics of winter wheat accumulation cultivated on brown luvic soils. As biological material, the Delia variety of wheat was employed.

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

RESULTS AND DISCUSSIONS

This paper presents the correlation between biomass accumulation and forerunner plant quality in winter wheat cultivation in terms of the climatic conditions of the current year.

Table 1 presents the biomass accumulation during the less favourable year 2010. The results show that the forerunner plant does not influence biomass accumulation increase as winter wheat advances in vegetation. The increase is dependent on the properties and quality of the forerunner plant, the best yields being obtained in the cultivation after pea. Thus, in wheat monoculture the biomass accumulation increases from 0,96 g. of dry weight/10 plants (at the beginning of winter) to 45.40 g. of dry weight/10 plants at complete ripening. If corn is used as forerunner plant, but especially after pea, the increases in yield are superior, varying from 0.87-60.43 g. dry weight/10 plants after corn to 1.50-66.97 g. dry weight/10 plants after pea, respectively as forerunner plants for the winter wheat.

The phenomenon keeps the same pace, yet the values obtained in 2011 indicate a less favourable year (table 2). The biomass accumulation varies in wheat monoculture between 0.20-35.60 g. dry weight/10 plants and 0.23-42.83 g. dry weight/10 plants after corn and between 0.20-47.10 g. dry weight/10 plants after pea. Regardless of climatic conditions, at a different scale, a positive correlation was found between phenophase x fertilization level: as wheat advances to maturity, there is a progressive accumulation of total biomass in seeds (table 3 and 4).

Concerning 2010, a less favorable year, the results show a very significant increase in biomass at the beginning of winter in unfertilized alternative (1.00 g dry weight/10 plants). At complete ripening there is an increase to 49.92 g dry weight/10 plants in the unfertilized alternative (Zăhan, Rodica Zăhan, 1989).

In 2011, also a less favorable year, biomass accumulation decreases as compared to a favorable year, taking values in a narrower range between 0.22 g dry weight/10 plants at the beginning of winter and 31.32 g dry weight/10 plants as compared ripening values in unfertilized alternative. It is worth mentioning that in 2006 (a less favorable year) the quantity of accumulated biomass was directly proportional with fertilization, on level as it was rising during study period (49.92 g dry weight/10 plants) in unfertilized alternative and 69.49 g dry weight/10 plants in fertilized alternative, organo-mineral complex was used as fertilizer in all experimental alternative.

In a less favorable year, 2010, biomass accumulation decreased depending on fertilization level (31.32 g dry weight/10 plants in unfertilized alternative and 51.80 g dry weight/10 plants in fertilized alternative using the same organo-mineral complex as fertilizer).

It is worth mentioning that during the two research years, a negative correlation was found between the participation percentage of compound synthesized before fructification and seed formation and fertilization level.

As fertilization level increases, the participation percentage of compounds synthesized before fructification insides formation decreases. This phenomen is more accentuated in unfertilized alternatives as compared with fertilized ones with organo-mineral complex and is influenced by unfavorable climatic conditions.

Thus, in 2010, a favorable year, the increase in fertilization resulted in the decrease of participation percentage from 33.7 g dry weight/10 plants in unfertilized alternative to 15.3 g dry weight/10 plants in fertilized with organo-mineral complex alternatives.

In 2011, considered an unfavorable year, the decreases varied between 11.2 g dry weight/10 plants in unfertilized and 7.9 g dry weight/10 plants in fertilized alternatives using organo-mineral complex of fertilizers.

Table 1

The effect of the forerunner plant x phenophase on winter wheat biomass accumulation dynamics, on brown luvic soils Oradea 2010

Phenophase	Total dry weight biomass, seeds and straw g./10 plants											
	Forerunner plant											
	Wheat			Corn			Pea III			Pea IV		
	Totals d.W.	Seeds	Straw	Totals d.W.	Seeds	Straw	Totals d.W.	Seeds	Straw	Totals d.W.	Seeds	Straw
At the beginning of winter	0.96	-	0.96	0.87	-	0.87	0.87	-	0.87	1.50	-	1.50
At the end of winter	1.07	-	1.07	1.07	-	1.07	1.57	-	1.57	2.20	-	2.20
The beginning of vegetation	1.93	-	1,93	2,96	-	2,96	4,27	-	4,27	4,07	-	4,07
The formation of first interned	5.27	-	5,27	5,10	-	5,10	7,80	-	7,80	6,27	-	6,27
Straw elongation	13.47	-	13,47	19,17	-	19,17	17,17	-	17,17	14,00	-	14,00
The formation of spike	31.50	-	31,50	29,50	-	29,50	54,60	-	54,60	49,53	-	49,53
Beginning of seeds formation	34.63	-	34,63	42,83	-	42,83	57,90	-	57,90	54,63	-	54,63
Early ripening	39.67	10.00	29,67	52,90	13,33	39,57	59,93	14,33	45,60	56,80	11,00	45,80
Incomplete ripening	45.33	12.53	32,80	57,10	15,93	41,17	62,50	21,67	40,83	62,67	18,67	44,00
Complete ripening	45.40	15.67	29,73	60,43	24,33	36,10	63,60	27,00	36,60	66,97	30,67	36,30
DL 5% DL 1 % DL 0,1 %	For total plant biomass 0.071 g/10 plants d.w. 0.093 g/10 plants d.w. 0.119 g/10 plants d.w.						For seeds: 2.7 g/10 plants d.w. 3.6 g/10 plants d.w. 4.7 g/10 plants d.w.					

% participation of synthesised compounds prior to fructification and seeds' formation:
Wheat = 14.1%; Pea III = 36.8%;
Corn = 15.7%; Pea IV = 33.5%;

Table 2.

The effect of the forerunner plant x phenophase on winter wheat biomass accumulation dynamics on brown luvic soils Oradea 2011

Phenophase	Total dry weight biomass. seeds and straw g./10 plants											
	Forerunner plant											
	Wheat			Corn			Pea III			Pea IV		
	Totals d.W.	Seeds	Straw	Totals d.W.	Seeds	Straw	Totals d.W.	Seeds	Straw	Totals d.W.	Seeds	Straw
At the beginning of winter	0.20	-	0.20	0.23	-	0.23	0.30	-	0.30	0.20	-	0.20
At the end of winter	0.37	-	0.37	0.37	-	0.37	0.40	-	0.40	0.37	-	0.37
The beginning of vegetation	0.47	-	0.47	0.47	-	0.47	0.50	-	0.50	0.47	-	0.47
The formation of first interned	0.80	-	0.80	0.97	-	0.97	1.33	-	1.33	0.93	-	0.93
Straw elongation	3.73	-	3.73	3.43	-	3.43	4.37	-	4.37	4.33	-	4.33
The formation of spike	8.60	-	8.60	9.47	-	9.47	11.0	-	11.00	10.60	-	10.60
Beginning of seeds formation	24.83	-	24.83	25.50	-	25.50	34.03	-	34.03	33.13	-	33.13
Early ripening	33.87	9.83	24.04	36.00	8.50	27.50	35.73	11.33	24.40	41.33	10.83	30.50
Incomplete ripening	35.37	11.70	23.67	41.87	11.00	30.87	40.73	13.90	26.83	45.33	12.17	33.16
Complete ripening	35.60	13.37	22.23	42.83	12.80	30.03	43.43	17.50	25.93	47.10	15.97	31.13
DL 5%	.For total plant biomass: 0.073 g/10 plants d..w.						For seeds: 2.7 g/10 plants d.w.					
DL 1 %	0.096 g/10 plants d.w.						3.6 g/10 plants d.w.					
DL 0.1 %	0.123 g/10 plants d.w.						4.7 g/10 plants d.w.					

% participation of synthesised compounds prior to fructification and seeds' formation:

Wheat = 10.5 %; Pea III = 28.3%;

Corn = 17.4%; Pea IV = 8.0 %.

Table 3

The effect of fertilisation level x phenophase interaction on winter wheat dry weight biomass accumulation dynamics on brown luvic soils. Oradea 2010

Phenophase	Total dry weight biomass. seeds and straw g./10 plants								
	Fertilisation level								
	N_0P_0			$N_{120}P_{80}$			$N_{100}P_{80}$ + 10t/ha manure		
	Total s d.W.	Seeds	Straw	Total s d.W.	Seeds	Straw	Total s d.W.	Seeds	Straw
At the beginning of winter	1.00	-	1.00	1.17	-	1.17	0.97	-	0.97
At the end of winter	1.22	-	1.22	1.55	-	1.55	1.65	-	1.65
The beginning of vegetation	2.65	-	2.65	2.62	-	2.62	4.65	-	4.65
The formation of first interned	4.77	-	4.77	6.10	-	6.10	7.45	-	7.45
Straw elongation	11.62	-	11.62	16.85	-	16.85	19.37	-	19.37
The formation of spike	36.70	-	36.70	43.05	-	43.05	44.10	-	44.10
Beginning of seeds formation	43.62	-	43.62	49.55	-	49.55	49.31	-	49.31
Early ripening	47.62	9.50	38.12	52.90	13.75	39.15	56.45	13.25	43.20
Incomplete ripening	49.82	15.75	34.07	57.32	18.45	38.87	63.55	17.40	46.15
Complete ripening	49.92	21.00	28.92	57.95	24.50	33.45	69.49	27.75	41.74
DL 5% DL 1 % DL 0.1 %	For total green mass: 0.063 g/10 plants d.w. 0.083 g/10 plants d.w. 0.106 g/10 plants d.w.						For seeds: 2.3 g/10 plants d.w. 3.1 g/10 plants d.w. 4.0 g/10 plants d.w.		

% participation of synthesised compounds prior to fructification and seeds' formation:

N_0P_0 = 33.7 %;

$N_{120}P_{80}$ = 32.5 %;

$N_{100}P_{80}$ + 10t/ha manure = 15.3 %

Table 4

The effect of fertilisation level x phenophase interaction on winter wheat dry weight biomass accumulation dynamics on brown luvic soils. Oradea 2011

Phenophase	Total dry weight biomass. seeds and straw g./10 plants								
	Fertilisation level								
	N_0P_0			$N_{120}P_{80}$			$N_{100}P_{80}$ + 10t/ha manure		
	Total s d.W.	Seeds	Straw	Total s d.W.	Seeds	Straw	Total s d.W.	Seeds	Straw
At the beginning of winter	0.22	-	0.22	0.22	-	0.22	0.25	-	0.25
At the end of winter	0.35	-	0.35	0.37	-	0.37	0.40	-	0.40
The beginning of vegetation	0.45	-	0.45	0.47	-	0.47	0.50	-	0.50
The formation of first interned	0.90	-	0.90	0.95	-	0.95	1.17	-	1.17
Straw elongation	2.45	-	2.45	4.47	-	4.47	4.97	-	4.97
The formation of spike	5.82	-	5.82	11.30	-	11.30	12.62	-	12.62
Beginning of seeds formation	23.00	-	**23.00**	30.07	-	**30.07**	35.05	-	**35.05**
Early ripening	26.45	6.03	**20.42**	38.97	11.85	**27.12**	44.77	12.50	**32.27**
Incomplete ripening	30.22	7.35	22.87	43.05	14.07	28.98	49.20	15.15	34.05
Complete ripening	31.32	9.72	21.60	43.60	15.70	27.90	51.80	19.30	32.50
DL 5% DL 1 % DL 0.1 %	For total green mass: 0.063 g/10 plants d.w. 0.083 g/10 plants d.w. 0.106 g/10 plants d.w.						For seeds: 2.3 g/10 plants d.w. 3.1 g/10 plants d.w. 4.0 g/10 plants d.w.		

% participation of synthesised compounds prior to fructification and seeds' formation:

N_0P_0 = 11.2 %;

$N_{120}P_{80}$ = 9.8 %;

$N_{100}P_{80}$ + 10t/ha manure = 7.9 %

CONCLUSIONS

The quality of the forerunner plants has a positive effect on total biomass accumulation as compared with wheat monoculture, the obtained values being conditioned by a higher favourableness of climatic factors. With regard to biomass accumulation in seeds, it was positively influenced by the quality of the forerunner plant, being higher in correlation with the better qualities of the forerunner plants.

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