

## EFFECT OF CROPS FERTILIZATION IN THE HILLY AREA OF THE MOLDAVIAN PLAIN

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### Abstract

*The experiments were conducted on a degraded medium chernozem, on the Eastern and Central side of Moldavia and it was studied the behavior of some cultures as preliminary for the autumn wheat and the influence of different quantities of chemical fertilizers on these cultures and the remaining effect on the wheat. The experiments were organized in four repetitions and in order to appreciate in comparison the yields obtained, the energetic balance-sheet was calculated, taking into consideration the energetic consumption with the fertilizers used and the energetic value of the production efficiency obtained during the first year at the preliminary plant and during the second year at wheat. The medium energetically value of the crop efficiency obtained at the preliminary culture and at wheat was situated between 6927 and 3076 Mcal/ha, decreasing for the fifth preliminary ones, including wheat, silo maize, sugar beet, potato, Sudan grass and maize for grains. The fertilization of some preliminary for the autumn wheat registered the following efficiency (average values of the balance-sheet) during the first two years after applying the fertilizers: silo maize 4264 Mcal/ha, Sudan grass 1158 Mcal/ha, potato 832 Mcal/ha and maize for grains 397 Mcal/ha.*

Keywords: fertilization, soil erosion, yields, energetic balance

## 1. INTRODUCTION

Wheat represents one of the important cultures for our country and fertilizing increases crops significantly. In order to use rationally the fertilizers and to choose the doses and proper proportions, one must take into account the soil fertility, the preliminary plant, and the climate conditions. Some researchers demonstrate that in order to correctly use fertilizers, one must take into account their effect in the second and third year after application. Halmagean [5] shows that at the chemical fertilizers containing nitrogen, the coefficient of use at field crops is about 38 - 48 %, the phosphorus 12 - 15 % and at the potassium ones 28 - 71 %. Fertilizers stimulate the development of the airy and underground parts of the plant and increase the quantity of vegetable remainders, still in soil after the harvest has taken place. Davidescu Velicica et al. [4] show that maize leaves in soil 4 - 7 t/ha organic remainders, the beet 5 - 6 t/ha, and potato 0.5 t/ha. Due to this fact, some preliminary ones less suitable to wheat may be changed, through fertilization, into good preliminary ones.

It was ascertained in this paper the effect of fertilizers with nitrogen, phosphorus and

potassium on the cultures of maize for grain, white beet, potato, silo maize and Sudan grass, as well as the remaining effect of the fertilizers on the cultivated wheat after these preliminary fertilized crops. In order to establish the efficiency of the different quantities of fertilizers, the energetic balance sheet was calculated too.

## 2. MATERIAL AND METHOD

The experiments were made on the Ezareni Experimental Station belonging to University of Agricultural Sciences and Veterinary Medicine Iasi, situated on the superior terrace of the Bahlui River. The soil, a degraded medium chernozem, clayed, formed on loessoid deposits, had the medium content of humus of 3.97 % and the content of nitrogen and phosphorus was low. The experiments with maize, potato and beet took place on a degraded medium chernozem, with a slope of 9 - 10 %, the horizon A in little erosion, with 25 - 35 cm in thickness. The content in humus was 2.25 - 2.23 %, neutral pH, and the nitrogen, phosphorus and potassium, between 0.21 - 0.26 N, 0.16 - 0.17 % P<sub>2</sub>O<sub>5</sub> and 2.04 - 2.16 K<sub>2</sub>O. The multiannual mean of the rainfall in

the area of experiment is have 517.8 mm, and the multiannual temperature mean, of 9.6 Celsius degree. The repartition of the rainfall was irregular and the periods of draught have reduced the yield, in general.

The preparation of the land started in autumn and, along with the plough land the superphosphate and the salt of potassium were applied and the nitrate of ammonium was given in spring, before the sowing (planting). There were used the departmental variety from the central part of Moldavia and the sowing was made at the best time. After cropping the preliminary cultures, the plough was made and during the first half of October the autumn wheat was sown without applying fertilizers. The experiments were organized in four repetitions and in order to appreciate in comparison the yields obtained, the energetic balance-sheet was calculated, taking into consideration the energetic consumption with the fertilizers used and the energetic value of the production efficiency obtained during the first year at the preliminary plant and during the second year at wheat.

### 3. RESULTS AND DISCUSSION

Researching the behavior of the wheat for grains as preliminary for the autumn wheat, it was ascertained the fertilizers applied to the

first culture increased the maize crop by 352 - 838 kg/ha or the equivalent, 1380 - 3286 Mcal/ha and at the wheat which followed after the maize, the increase of the crop was of 57 - 291 kg/ha or 291-1106 Mcal/ha (*table 1*). Similar crop efficiency was obtained in other experiments as well, organized by Mogarzan and his team [6]. The most appropriate dose of fertilizers was of 120 N+ 105 P<sub>2</sub>O<sub>5</sub> kg/ha. The potassium fertilizers didn't contribute to increasing the crop, thing ascertained by other experiments made in the area by I. Costache et al (2003). The increase of the superphosphate dose grew the remaining effect of the fertilizers at wheat. The best energetic balance of the two cultures, of 1043-1045 Mcal/ha, was obtained at the dose of 45 N + 30 P<sub>2</sub>O<sub>5</sub> Kg/ha and of 120 N + 105 P<sub>2</sub>O<sub>5</sub> Kg/ha.

The white beet valued the fertilizers, in the first year after application the medium efficiency of crop being situated between 4496-5710 kg roots/ha and 4406 - 5596 Mcal/ha (*table 2*). In the second year after application, fertilizers increased the wheat crop with 47 - 253 kg/ha or 180 - 971 Mcal/ha. The most appropriate dose of fertilizers was of 105 N+ 120 P<sub>2</sub>O<sub>5</sub> + 60 K<sub>2</sub>O kg/ha. The high energetic balance, 3510 - 3268 Mcal/ ha was obtained at the dose of 105 N + 120 P<sub>2</sub>O<sub>5</sub> + 60 K<sub>2</sub>O kg/ha or 45 N + 30 P<sub>2</sub>O<sub>5</sub>+ 30 K<sub>2</sub>O kg/ha. At a small dose of fertilizer, the remaining effect was lower.

**Table 1** The influence of the chemical fertilizers on the culture production of maize for grains the first year after application and on the wheat in the second year

Variant	Fertilizers a. s.				Maize for grain		Wheat		Total preceding + wheat Mcal/ha	Energetic Balance 2 years Mcal/ha
	N	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O	Total Mcal/ha	Yield increase					
	Kg/ha				Kg/ha	Mcal/ha	Kg/ha	Mcal/ha		
1	Unfertilized variant									
2	45	30	-	1140	501	1964	57	219	2183	1043
3	90	60	-	2281	352	1380	179	687	2067	-214
4	105	90	-	2758	501	1964	256	982	2946	188
5	90	30	-	2135	501	1964	75	288	2252	117
6	45	60	-	1286	501	1967	65	249	2216	930
7	120	90	-	3090	679	2662	256	982	3644	554
8	105	90	40	2860	733	2874	233	894	3768	908
9	120	105	-	3162	838	3286	240	921	4207	1045
10	150	120	-	3898	838	3286	291	1116	4402	504

The fertilizers applied to the potato culture increased the root crop with 2636 - 4952 kg/ha or 2193 - 4120 Mcal/ha. Big yields was obtained at the wheat cultivated after the potato, unlike the one cultivated after maize. The proper fertilizer dose was about 150 N + 120 P<sub>2</sub>O<sub>5</sub>+ 60 K<sub>2</sub>O kg/ha. The highest values of

the energetic balance mean were about 1208 or 1390 Mcal/ha and were obtained at the fertilizer quantity of 45 N +45 P<sub>2</sub>O<sub>5</sub>+ 40 K<sub>2</sub>O/kg or 60 N + 90 P<sub>2</sub>O<sub>5</sub> +40 K<sub>2</sub>O kg/ha. When increasing the dose of superphosphate, the remaining effect of the fertilizers upon wheat increased.

**Table 2 The influence of the chemical fertilizers on the cultures production of sugar beet and sugar in the first year after application and upon wheat during the second year**

Variant	Fertilizers a. s.				Preliminary		Wheat		Total preceding + wheat Mcal/ha	Energetic Balance 2 years Mcal/ha	
	N	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O	Total Mcal/ha	Yield increase						
	Kg/ha				Kgha	Mcal/ha	Kg/ha	Mcal/ha			
Sugar beet (mean on 3 years)					Mean on 3 years						
1	Unfertilized variant										
2	45	30	30	1217	4760	4665	47	180	4845	3628	
3	105	90	40	2860	4496	4406	221	848	5254	2394	
4	105	45	40	2641	5312	5206	86	330	5536	2895	
5	90	60	30	2357	4760	4665	171	656	5321	2964	
6	60	90	40	2333	5312	5206	112	430	5636	3303	
7	105	105	40	2933	5312	5206	231	886	6092	3159	
8	105	90	-	2758	1156	4367	212	813	5180	2422	
9	120	105	40	3264	5630	5517	228	875	6392	3128	
10	105	120	60	3057	5710	5596	253	971	6567	3510	
Potato (mean on 3 years)					Mean on 3 years						
1	Unfertilized variant										
2	45	45	40	1315	2636	2193	86	330	2523	1208	
3	90	90	40	2528	3641	3029	149	572	3601	1073	
4	120	105	60	3315	4474	3722	149	572	4294	979	
5	120	105	-	3162	3949	3286	172	660	3946	784	
6	150	120	60	4051	4952	4120	166	637	4757	706	
7	105	105	40	2933	3641	3029	120	460	3489	556	
8	120	90	40	3191	3641	3029	120	460	3489	298	
9	90	45	40	2310	3641	3029	65	249	3278	968	
10	60	90	40	1865	3641	3029	61	234	3263	1398	
11	150	105	60	3978	4474	3722	159	610	4332	354	

The fertilizers applied to the culture of Sudan grass increased the hay crop with 307 - 898 kg/ha or 1125 - 3290 Mcal/ha (table 3). It was ascertained the positive effect of fertilizers with nitrogen applied together with the phosphoric and the potassium ones. Applied isolated (V<sub>2</sub>), they registered a crop efficiency of 77 - 289 kg/ha or 295 - 1109 Mcal/ha. The biggest crops at both cultures have been obtained at the dose of 90 N + 60 P<sub>2</sub>O<sub>5</sub>+40 K<sub>2</sub>O kg/ha. The energetic balance sheet oscillated between 96 and 2016 Mcal/ha, with the highest values at the fertilizer dose mentioned before. At the maize cultivated for silo, fertilizers increased the crop with 5527 - 10191 kg/ha

green mass or 3731 - 6879 Mcal/ha (table 3). The most appropriate dose was of 150 N+ 90 P<sub>2</sub>O<sub>5</sub> + 30 K<sub>2</sub>O kg/ha. Similar doses of fertilizer proved to be appropriate for the silo maize in other parts of the country too. The remaining effect of fertilizers for the wheat cultivated after the silo maize was shown by the crop efficiency situated between 45 - 308 kg/ha or 173 - 1181 Mcal/ha. At the dose of 150 N +105 P<sub>2</sub>O<sub>5</sub> kg/ha it was obtained the highest efficiency of the grain maize production. The increase of the superphosphate dose from 45 to 105 kg P<sub>2</sub>O<sub>5</sub> grew the remaining effect of fertilizers on the wheat. The energetic balance sheet was situated

between 5021 and 5065 Mcal/ha at the doses of 75N + 90 P<sub>2</sub>O<sub>5</sub> kg/ha and 105 N + 90 P<sub>2</sub>O<sub>5</sub> kg/ha + 30 K<sub>2</sub>O kg/ha.

If we ascertain in comparison the energetic average value of the crop efficiency obtained thanks to the fertilizers at the five crops and at the wheat which followed them, we may take into account the fact that at the silo maize and

at the white beet, followed by wheat, it was obtained the highest crop efficiency, of 6927 and 5647 Mcal/ha (*table 4*). The fertilizers were valued and were good preliminary for wheat, tomato, maize, Sudan grass, cultures at which the energetic value of the crop efficiency was, on average, of 3697 Mcal/ha, 3076 Mcal/ha and 3027 Mcal/ha.

**Table 3 The influence of the chemical fertilizers on the cultures of Sudan grass and maize for silo in the first year after application and on wheat during the second year**

Variant	Fertilizers a. s.				Preliminary		Wheat		Total preceding + wheat Mcal/ha	Energetic Balance 2 years Mcal/ha
	N	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O	Total Mcal/ha	Yield increase					
	Kg/ha				Kg/ha	Mcal/ha	Kg/ha	Mcal/ha		
Sudan grass (mean on 3 years)							Mean on 3 years			
1	Unfertilized variant									
2	60	-	-	1324	307	1125	77	295	1420	96
3	60	30	-	1472	533	1952	170	652	2604	1132
4	90	30	-	2135	714	2615	201	771	3386	1251
5	90	60	-	2281	707	2590	270	1036	3626	1345
6	90	60	40	2383	898	3290	289	1109	4399	2016
7	60	60	-	1618	535	1960	200	767	2727	1109
8	60	-	-	1324	307	1125	77	295	1420	96
9	60	30	-	1472	533	1952	170	652	2604	1132
10	90	30	-	2135	714	2615	201	771	3386	1251
Silo maize (mean on 3 years)							Mean on 3 years			
1	Unfertilized variant									
2	60	45	-	1545	3731	3731	45	173	3904	2359
3	90	60	-	2281	5527	3731	191	733	4464	2183
4	105	90	-	2758	9871	6663	296	1135	7798	5040
5	105	60	-	2612	9871	6663	121	464	7127	4515
6	150	105	-	3825	9972	6731	308	1181	7912	4087
7	120	90	-	3090	9972	6731	255	978	7709	4619
8	75	90	-	2095	9871	6663	118	453	7116	5021
9	105	90	30	2834	10191	6879	266	1020	7899	5065
10	105	120	-	2904	9871	6663	270	1036	7699	4795
11	105	75	-	2685	9871	6663	255	978	7641	4956

As it was ascertained in other experiments mentioned by Gh. Barnaure (1976), the maize cultivated for grains was proved to be a mediocre preliminary for wheat and the white beet, a good preliminary.

In order to appreciate the energetic efficiency of some doses of fertilizers applied to different preliminary and the remaining effect on wheat, the energetic balance sheet was also calculated.

The highest average values were registered at the silo maize or white beet and the maize cultivated after these were of 4264 Mcal/ha and 3045 Mcal/ha. Lower average values of the energetic balance sheet were registered at the Sudan grass, potato and maize, followed by wheat and were of 1158 Mcal/ha, 832 Mcal/ha and 397Mcal/ha.

**Table 4** The influence of the chemical fertilizers on the yield of some cultures during the first year after application and on wheat during the second year

Variant	Maize for grains + wheat (Mcal/ha)		Sugar beet + wheat (Mcal/ha)		Potato + wheat (Mcal/ha)		Silo maize + wheat (Mcal/ha)		Sudan grass + wheat (Mcal/ha)	
	Total	Balance	Total	Balance	Total	Balance	Total	Balance	Total	Balance
2	2183	1043	4845	3628	2523	1208	3904	2359	1420	96
3	2067	-214	5254	2394	3601	1073	4464	2183	2604	1132
4	2946	188	5536	2895	4294	979	7789	5040	3386	1251
5	2252	117	5321	2964	3946	784	7127	4515	3626	1345
6	2216	930	5636	3303	4757	706	7912	4087	4399	2016
7	3644	554	6092	3159	3489	556	7709	4619	2727	1109
8	3768	908	5180	2422	3489	298	7116	5021	-	-
9	4207	1045	6392	3128	3278	968	7899	5065	-	-
10	4402	504	6567	3510	3263	1398	7699	4795	-	-
11	-	-	-	-	4332	354	7641	4956	-	-
Mean	3076	397	5647	3045	3697	832	6927	4264	3027	1158

#### 4. CONCLUSIONS

Observing the effect of the chemical fertilizers during the first two years after application, one may better appreciate their efficiency.

The remaining effect of the fertilizers grows at the same time with the increase of the dose, but breaking some limits, the increase of the dose becomes inefficient from the economical and chemical point of view.

Under the pedoclimatic conditions from the Eastern and Central part of Moldavia, the fertilizer doses applied to wheat cultures, efficient from the energetic point of view, were as follows: silo grain 105N + 90 P<sub>2</sub>O<sub>5</sub>+ 30 K<sub>2</sub>O/kg/ha; sugar beet 105 N + 120 P<sub>2</sub>O<sub>5</sub> +60 K<sub>2</sub>O/kg; the Sudan grass 90 N + 60 P<sub>2</sub>O<sub>5</sub> + 40 K<sub>2</sub>O kg/ha; potato 150 N +120 P<sub>2</sub>O<sub>5</sub> + 60 K<sub>2</sub>O/kg/ha; the maize for grains 120 N + 150 P<sub>2</sub>O<sub>5</sub>.

The increase of the super phosphate dose grew the remaining effect of fertilizers on wheat;

The fertilization of some preliminary for the autumn wheat registered the following efficiency (average values of the balance-sheet) during the first two years after applying the fertilizers: silo maize 4264 Mcal/ha, Sudan grass 1158 Mcal/ha, potato 832 Mcal/ha and maize for grains 397 Mcal/ha.

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