THE EFFECT OF FERTILIZERS CONCERNING THE MILLET YIELDS, ON A SOIL UNDER CONTROL POLLUTED BY PETROLEUM RESIDUES

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Abstract
The paper presents the partial results of researches regarding the agrochemical melioration of soils under control polluted by petroleum residues that took place at the Agricultural and Research and Development Station in Oradea, Bihor County.
The experimental device was made out of 1 m^2 microparcels, spread out in subdivided parcels, in four repetitions, having tree factors: A - the pollution by crude oil from Suplacu de Barcău, B – the mineral fertilization, and C – the organic fertilization.
The experience was set out on a preluvosoil în the year 1993 and the soil was cultivated with millet in the first 3 years and with spring wheat in the last 7 years of research.

Key words: soil pollution, petroleum residues, crude oil, agrochemical melioration;

INTRODUCTION

Soil pollution with oil residue is a very complex phenomenon, determined by crude oil, salty water and derrick sludge, which are manifest, in our country, on a surface of land of over 50 mii ha, with preponderance lands with agricultural utilization (Sabău et al., 2002)

In the conditions of Bihor County, oil extraction, processing and transport of petroleum products took place at the sites in Suplacu de Barcău, Marghita and Oradea, which have nowadays stations for OMV company and Petrolsub S.A. Suplacu d Barcău Rafinery. It are estimated that this activities are determined an historical pollution of soils on about 250 ha, which requires melioration works. (Şandor et al., 2007)

The research carried out in the south of Romania (Toti et al., 2003) concerning the melioration of agricultural lands polluted by crude oil from extraction fields, have provided that the plant's average life expectation diminished after a pollution of 1 kg/m^2 (0,3 %) oil residue in the ploughed layer.

For the conditions from Western Romania, Colibaş et al., 1995 published the first partial results of researches regarding yield losses in millet, after the first year of controlled pollution with different doses of crude oil, from Suplacu de Barcău on the preluvosoil from Agricultural Research and Development Station Oradea.

Later, Şandor et al., 2007 Şandor and Sabău 2007 and Sabău et al. 2009, publish the results of yields, of some parcels polluted under control, at the experimental field from the Agricultural Research and Development Station Oradea and some correlations between yields and crude oil concentrations.

MATERIAL AND METHODS

The researches carried out in Oradea have like objective the study of organic and mineral fertilizers effect on millet-hay yields, in the time of melioration process of a soil under control polluted with crude oil, from Suplacu de Barcău, Bihor County.

Taking in consideration that on Romanian territory, from the surface which are affected by pollution with petroleum residue and salty water, near a half (49,4 %) is occupied by luvisoils and the type soil preponderantly polluted with crude oil at Suplacu de Barcău is also luvosoil, the experience carried out at Agricultural Research and Development Station Oradea, was placed also on a luvisoil.

The experiment looking "The agrochemical melioration of polluted by petroleum residue of soils" is an experiment having tree factors, the type 2 x 4 x 4, with microparcels of 1 m^2, set out randomized, in four repetitions after the system of subdivided parcels. (Fig. 1.)

The studied factors are:

The factor A: Pollution by crude oil:

a_1 – control unpolluted;

a_2 – polluted by crude oil, in concentration of 3 % (9 l/m^2) on ploughed layer;

The factor B: Organic fertilizer:

b_0 – 0 t/ha manure;

b_1 – 50 t/ha manure;

b_2 – 100 t/ha manure;

b_3 – 150 t/ha manure;

The factor C: Mineral fertilizer:

c_0 – $N_0P_0K_0$ kg/ha;

c_1 – $N_{100}P_{80}K_{70}$ kg/ha;

c_2 – $N_{200}P_{160}K_{140}$ kg/ha;

c_3 – $N_{300}P_{240}K_{210}$ kg/ha;

The experimental device was carried out in 1993, at the same time with the experiment looking the study of different doses of petroleum residue effect on yields, being cultivated in the first tree years with millet and than in the next seven years with spring wheat, Speranța breed.

The experimental field with microparcels from Oradea

The Experiment: "The agrochemical melioration of polluted by petroleum residue of soils"

The Factors:

A – Pollution by crude oil;
a_1 – control unpolluted
a_2 – polluted, 3 % crude oil;

B – Organic Fertilizer;
b_0 – 0 t/ha manure;
b_1 – 50 t/ha manure;
b_2 - 100 t/ha manure;
b_3 – 150 t/ha manure;

C – Mineral Fertilizer
c_0 – $N_0\ P_0\ K_0$ kg/ha s.a.
c_1 – $N_{100}\ P_{80}\ K_{70}$;
c_2 – $N_{200}\ P_{160}\ K_{140}$;
c_3 – $N_{300}\ P_{240}\ K_{210}$;

	c_2	c_3	b_3	c_1	c_0	c_0	c_3	b_0	c_2	c_1	c_3	c_0	b_1	c_2	c_1	c_3	c_0	b_2	c_2	c_1	*a*
R_{IV}	c_0	c_2	b_1	c_3	c_1	c_2	c_1	b_3	c_3	c_0	c_2	c_3	b_2	c_1	c_0	c_2	c_1	b_0	c_3	c_0	*a*
	c_3	c_1	b_2	c_0	c_2	c_3	c_0	b_1	c_1	c_2	c_1	c_2	b_0	c_0	c_3	c_0	c_2	b_3	c_1	c_3	*a*
R_{III}	c_1	c_0	b_1	c_2	c_3	c_1	c_2	b_0	c_0	c_3	c_0	c_1	b_3		c_2	c_1	c_3	b_2	c_0	c_2	*a*
	c_2	c_3	b_3	c_0	c_1	c_0	c_1	b_2	c_3	c_2	c_3	c_2	b_1	c_1	c_0	c_2	c_1	b_0	c_0	c_3	*a*
R_{II}	c_3	c_2	b_2	c_1	c_0	c_3	c_2	b_0	c_0	c_1	c_0	c_1	b_3	c_2	c_3	c_1	c_0	b_1	c_3	c_2	*a*
	c_1	c_0	b_1	c_3	c_2	c_1	c_3	b_3	c_2	c_0	c_2	c_0	b_0	c_3	c_1	c_0	c_3	b_2	c_2	c_1	*a*
R_I	c_0	c_1	b_0	c_2	c_3	c_2	c_0	b_1	c_1	c_3	c_1	c_3	b_2	c_0	c_2	c_3	c_2	b_3	c_1	c_0	*a*

Fig. 1. The Sketch of Experimental Field "The agrochemical melioration of polluted by petroleum residue of soils" from Oradea

RESULTS AND DISCUSSION

The average yields of the first tree research years (1993-1995) in which the experiment was cultivated with millet, was included between 34,7 q/ha and 54,0 q/ha millet-hay on control unpolluted variants while on the variants polluted by petroleum residue in 3 % concentration between 30,3 q/ha and 48,0 q/ha millet-hay (Fig. 2.)

The average of yields in all variants with organic and mineral fertilization studied, was of de 40,2 q/ha millet-hay, in the case of the parcels under control polluted by petroleum residue, more small with 4,7 q/ha than the average of variants with mineral and organic fertilization unpolluted, which is of 44,9 q/ha.

The smallest yield is obtained in the variant polluted with 3 % petroleum residue, without mineral and organic fertilization, it is of 30,3 q/ha, more small than in unpolluted variant, without mineral and organic fertilization of 4,4 q/ha millet-hay.

Both in the variants unpolluted and in the variants polluted by petroleum residue, the biggest yields are obtained for the maximum doses of mineral fertilizer, N_{300} P_{240} K_{210} and organic fertilizer, 150 t/ha manure, these being of 54,0 q/ha millet-hay and respectively 43,2 q/ha millet-hay, for the control unpolluted variants.

The agricultural yields of millet-hay, in the first tree years of observation have a general tendency of permanent growth. The yield differences between the control parcels, unpolluted and the parcels under control polluted by petroleum residue was of – 6,4 q/ha in 1993, - 5,3 q/ha in 1994 and – 2,9 q/ha in 1995, among which only in the first year of observation they presents the statistically signification. (Table 1.)

In the first year of observations, 1993 the positive yield differences, achieved of the organic fertilizer doses, was included between 2,3 and 12,8 q/ha, in the case of the control unpolluted variants and respectively between 2,2 and 5,2 q/ha in the case of under control polluted variants. These differences are distinctively significant and very significant statistic, in unpolluted variants, for the doses of 100 t/ha and respectively 150 t/ha manure, while in the case of variants under control polluted with petroleum residue, only the difference achieved by the maximum quantity of mineral fertilizer is distinctively significant.

The amounts of mineral fertilizer applied are determined the positive yield differences of 5,6 – 9,5 q/ha in the control unpolluted variants and of 3,7 – 7,5 q/ha millet-hay in the polluted variants, all of these being very significant statistically.

In the second year of the research, the yield differences achieved by organic fertilizer doses applied în unpolluted parcels (2,4 – 11,3 q/ha) keeps the same statistically significance, while in the polluted variants, the difference achieved in the second graduation (100 t/ha manure) of + 5,6 q/ha millet-hay, becomes statistically significant. The difference of + 8,0 q/ha, achieved by the biggest dose of organic fertilizer (150 t/ha manure) remains distinctively significant.

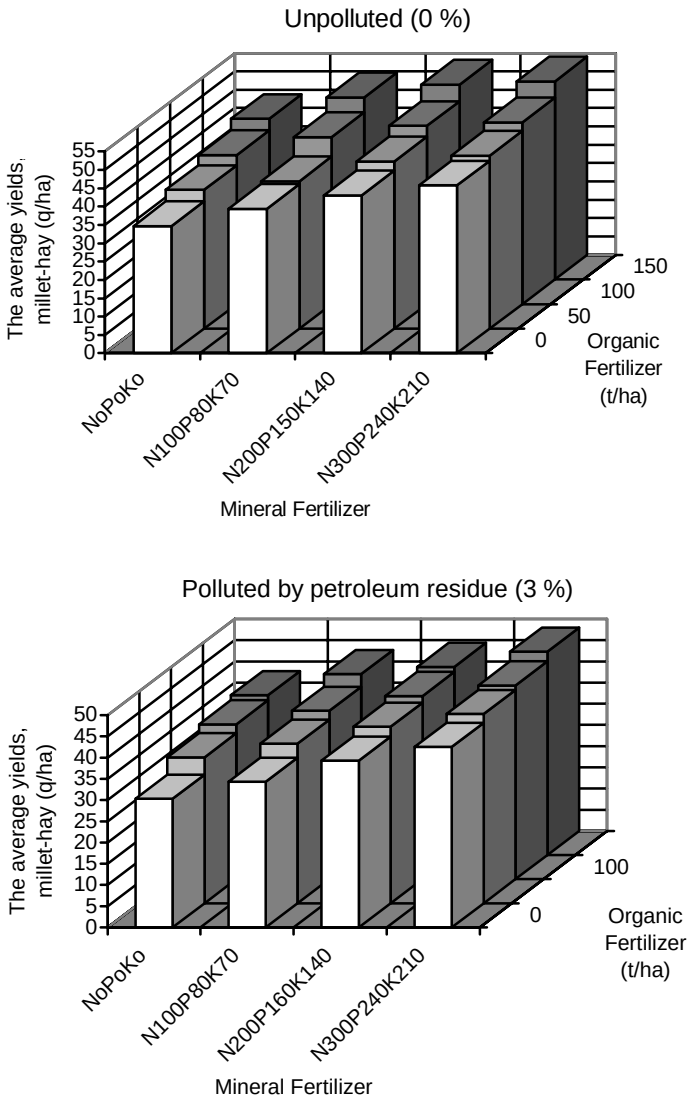

Fig.2. The average yields (1993-1995) of millet-hay (q/ha) in the variants with mineral and organic fertilizers in not polluted and polluted under control by petroleum residue (3 %) on ploughed layer, parcels

Table 1.

Yields millet – hay (q/ha)
The agrochemical melioration of polluted by petroleum residue of soils

The factor B: Organic fertilization	Years																			
	1993							1994							1995						
	The factor C: Mineral fertilization				Average B:	Differences q/ha	Significance	The factor C: Mineral fertilization				Average B:	Differences q/ha	Significance	The factor C: Mineral fertilization				Average B:	Differences q/ha	Significance
	c0	c1	c2	c3				c0	c1	c2	c3				c0	c1	c2	c3			
a1 Control unpolluted																					
b0	17,7	24,8	27,1	27,7	24,3	-		40,5	44,0	49,9	52,7	46,8	-		45,8	49,3	52,3	56,9	51,1	-	
b1	22,0	26,8	27,3	26,5	26,6	+2,3		43,7	41,7	53,7	57,6	49,2	+2,4		47,6	52,0	55,8	57,6	53,3	+2,2	
b2	25,8	28,1	31,0	29,4	29,4	+5,1	**	46,7	55,2	57,2	60,2	54,8	+8,0	**	49,3	53,3	57,5	59,0	54,8	+3,7	
b3	29,0	37,2	40,0	37,1	37,1	+12,8	***	50,5	57,0	61,0	64,0	58,1	+11,3	***	52,0	54,7	58,2	61,0	56,5	+5,4	*
Average C:	23,6	29,2	31,3	33,1	29,3			45,4	49,5	55,5	58,6	52,2			48,7	52,3	55,9	58,6	53,9		
Differences q/ha	-	5,6	7,7	9,5				-	4,1	10,1	13,2				-	3,6	7,2	9,9			
Significance		***	***	***					*	***	***						***	***			
a2 Polluted 3 % petroleum residue																					
b0	13,5	20,9	21,6	24,7	20,2	-		36,7	37,0	46,5	49,5	42,4	-		40,6	45,1	49,7	53,2	47,2	-	
b1	18,9	22,1	22,1	25,2	22,4	+2,2		41,2	43,2	49,2	53,5	46,8	+4,4		43,1	47,5	53,6	55,0	49,8	+2,6	
b2	20,5	23,0	23,0	26,0	23,5	+3,3		42,0	45,0	51,2	54,0	48,0	+5,6	*	47,0	51,2	55,3	57,0	52,6	+5,4	*
b3	22,4	24,0	24,0	29,1	25,4	+5,2	**	42,2	50,5	53,2	55,7	50,4	+8,0	**	48,6	53,6	56,1	59,3	54,4	+7,2	**
Average C:	18,8	22,5	23,9	26,3	22,9			40,5	43,9	50,0	53,2	46,9			44,8	49,3	53,7	56,1	51,0		
Differences q/ha	-	3,7	5,1	7,5	-6,4		o	-	3,4	9,5	12,7	-5,3			-	4,5	8,9	11,3	-2,9		
Significance		***	***	***					*	***	***					*	***	***			

	DL			DL			DL		
	5%	**1%**	**0,1%**	**5%**	**1%**	**0,1%**	**5%**	**1%**	**0,1%**
A x A	6,26	11,5	25,5	6,26	11,3	25,5	4,61	8,47	18,8
B x B	3,61	4,95	6,74	4,47	6,13	8,35	4,43	6,08	8,27
C x C	1,91	2,54	3,29	3,52	4,69	6,07	3,70	4,93	6,38

The effect mineral fertilizer administrated remains very significant statistically for the agricultural backgrounds N_{200} P_{160} K_{140} and N_{300} P_{240} K_{210}, both in the unpolluted variants (10,1 and 13,2 q/ha) and in polluted variants (9,5 and 12,7 q/ha), while in the case of small dose, N_{100} P_{80} K_{70} administrated in both variants, the differences of + 4,1 q/ha and respectively + 3,4 q/ha becomes statistically significant.

In the last year of millet cultivation the yield increases achieved by organic fertilizer on unpolluted variants, of 2,2 – 5,4 q/ha do not presents statistically signification, except the variant with maximum dose, for that the yield increasing is significant statistically. In the case of variants under control polluted by petroleum residue, the yield of + 5,4 q/ha and +7,2 q/ha are significantly and respectively distinctively significant statistically.

The effect of mineral fertilizer doses, in the third year of the research it reduced, for the control variant the yield increase achieved on minimum agricultural background (N_{100} P_{80} K_{70}) of + 3,6 q/ha do not present statistically signification. Remain very significant statistically the increases achieved by more big doses, respectively of 7,2 and 9,9 q/ha. In the case of the variants under control polluted by petroleum residue, the yield increases achieved by the mineral fertilizer doses of 4,5 – 11,3 q/ha, have the same statistically signification like in previous year.

Analyzing the yield differences evolution achieved by organic and mineral fertilizer doses applied remark the constant positive effect of the mineral fertilizer big doses, for that the yield increases are very significant statistically both in the unpolluted variants and in the polluted variants, in all years of the research. The manure big quantity haves distinctively significant and very significant effects for the control variants, în the first two years of observation, and respectively significant and distinctively significant for the variants under control polluted by petroleum residue, in the last two years of the observation.

CONCLUSIONS

The average yields of the first tree research years (1993-1995) in which the experiment was cultivated with millet, was included between 34,7 q/ha and 54,0 q/ha millet-hay on control unpolluted variants while on the variants polluted by petroleum residue in 3 % concentration between 30,3 q/ha and 48,0 q/ha millet-hay.

The yield differences between the control parcels, unpolluted and the parcels under control polluted by petroleum residue was of – 6,4 q/ha in 1993, - 5,3 q/ha in 1994 and – 2,9 q/ha in 1995, among which only in the first year of observation they presents the statistically signification.

The big mineral fertilizer doses have determined the yield increases vary significant statistically both in unpolluted and polluted variants, in all years of the research.

The manure big quantity haves distinctively significant and very significant effects for the control variants, în the first two years of observation, and respectively significant and distinctively significant for the variants under control polluted by petroleum residue, in the last two years of the observation.

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