# INFLUENCE OF FERTILIZATION SYSTEM ON THE PRODUCTION OF SPRING WHEAT IN THE IMPROVEMENT PERIOD OF A SOIL UNDER CONTROL POLLUTED WITH PETROLEUM RESIDUE

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***Abstract***

*The objective of this paper is to present the effect of mineral and organic fertilization systems on crop yields in the last seven years to improve of a soil, under control polluted with crude oil, in concentration of 3 % on plowed layer. Evolution of agricultural production of spring wheat in the years of observations had a decreasing trend in all variants studied, except for 1999, when they were higher in the unpolluted variant and organic and mineral fertilized variants. Average production gains are higher for manure administered on polluted version. At the dose of 50 t/ha manure administered the production gain in unpolluted version (1,12 q/ha) is statistically significant and in the polluted variant (1,43 q/ha) distinctly significant.*

**Key words:** soil pollution, petroleum residues, crude oil, organic fertilisation, mineral fertilisation.

## INTRODUCTION

Soil pollution by petroleum residues has as the main cause oil extraction, processing and transportation of petroleum products. The largest polluted areas are found in extraction fields, the pollution is produced with crude oil, salt water and mud probe.

In Romania polluted area in the largely agricultural use is estimated at 50 100 ha (Dumitru et al., 2006). In Bihor County, the area polluted with petroleum residue is concentrated in the fields of oil extraction from Suplacu de Barcău, Marghita and Oradea, where historical pollution covers approximately 250 ha, which requires ecological reconstruction works (Şandor, Sabău, 2007).

Based on the need for environmental remediation of these soils, Şandor Maria, initiated in 1993 at the Agricultural Research and Development Station Oradea, Laboratory of Soil Science and Land Reclamation the program "Research for the rehabilitation of degraded land with petroleum residue" as part of the national program "Monitoring of soil quality" financed by the Research Institute for Soil Science and Agrochemistry Bucharest (Şandor, 2011).

The first partial results of the research in the experience "Research on the influence of different doses of petroleum residue pollution on soil and

plant in haplic luvosoil conditions from Oradea" was published in 1995 (Colibaş et al., 1995).

Research conducted worldwide regarding recovery of polluted soil with petroleum residue showed that organic pollutants from soil, in time, are biodegraded under the influence of crops and specialized microorganisms (Atlas, 1981; Vidali, 2001; Dzhura et al., 2008).

The results of our research confirm the biodegradation of petroleum residues in the soil, due to its cultivation, without applying any kind of ameliorative works; this has been found by reducing pollutant concentrations (Şandor et al., 2007; Şandor, Sabău, 2007; Sabău, 2007; Sabău et al., 2009).

The technologies used for the rehabilitation of petroleum residue polluted soils using in addition to field cultivation with tolerant plants to pollution (Jingchun Tang et al., 2010) different ways to increase natural attenuation process of pollution, such as: amendment to correct soil reaction, manure or mineral fertilization for stimulating the activity of specialized microorganisms (Agarry et al., 2010) and inoculation of bacteria isolated from contaminated lands (Chaineau et al., 2005; Muthuswamy Sathishkumar et al., 2008).

Researches on the effect of crude oil pollution on plants in the south of Romania showed that crops suffer production losses from petroleum residue levels on plowed layer, higher than 1 kg/m2 (0.3%). Technology for the ecological restoration of these lands include in addition to amendment, mineral and organic fertilization, aerating the soil by deep loosening, the inoculum of bacteria isolated from petroleum sludge (Toti et al., 2003; Voiculescu et al., 2006).

The objective of this paper is to present the effect of mineral and organic fertilization systems on crop yields in the last years to improve of a soil, under control polluted with crude oil, in concentration of 3 % on plowed layer.

**MATERIAL AND METHOD**

To achieve the objectives, the study of the influence of organic and mineral fertilization systems on crop production during the improvement of a soil from Research and Development Station Oradea, controlled polluted with crude oil from Suplacu de Barcău, Bihor county was installed in 1993 a polifactorial experience with subdivided plots.

The soil of the experimental field is a haply luvisol with silty-loam texture in plowed horizon (Ap) and eluvial horizon (El) and respectively medium argillaceous under these horizons. The values of bulk density, small on plowing horizon and medium on eluvial horizon becomes large on

accumulation of clay horizon Bt and on the base of profile. Soil reaction is acidic on plowed horizon A, and then on deep it is weak acid.

The polifactorial experience is of type 2 x 4 x 4, with three factors, located in plots with micro parcels of 1 $m^2$, arranged randomized in three replications (Săulescu, Săulescu, 1967).

The studied factors are:

Factor A, Pollution: $A_0$ - witness unpolluted; $A_1$ – polluted on plowed horizon, 3 % crude oil;

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;

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 field was cultivated with millet, in the first three years (1993 – 1995) a plant that has an increased tolerance to soil pollution and then, in the last seven years (1996 - 2002) with spring wheat, Speranța bread.

**RESULTS AND DISCUSSION**

Experience of improving soils polluted with oil residues by using organic and mineral fertilization systems was pursued until the differences in production of spring wheat achieved in 2002, of the variants polluted and unpolluted became positive, statistically significant. In this year the yield of polluted variants was with 1.45 q/ha higher than in unpolluted variants.

Evolution of agricultural production of spring wheat in the last seven years of observations had a decreasing trend in all variants studied, except for 1999, when they were higher in the unpolluted variant and organic and mineral fertilized variants (Figure 1).

If in the first three years of observations (1996-1998) the lowest average yields were obtained for the variant polluted without fertilizer and the highest for unpolluted and mineral fertilized variants, since 1999 this trend has not been preserved.

Differences in production of the first two years (1996 and 1997) obtained in the mineral fertilized variants ($N_{100}P_{80}K_{70}$, $N_{200}P_{160}K_{140}$, $N_{300}P_{240}K_{210}$) higher in the polluted variant (3,83 to 7,45 q/ha) than unpolluted variant (1.08 to 4.15 q/ha) were very significant statistically.

Organic fertilization applied in the first two years with 50 t/ha manure has better effects in the variants polluted with oil 3%, the production increases of 2.25 q/ha in 1996 and 3.13 q/ha in 1997 are significant and very significant statistically, when in the variants unpolluted, the production increases of 1.53 q/ha and 2.00 q/ha no significance or is distinct significant. In the case when were applied 100 t/ha and 150 t/ha manure the production

increases are very significant statistically in both the variants polluted and unpolluted variants.

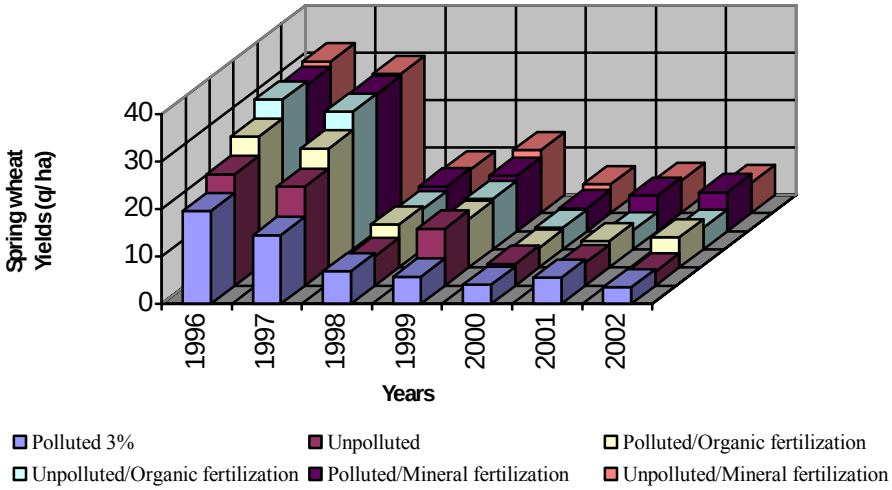


Fig. 1. Evolution of spring wheat yields (q/ha) in the experiment period

The yield differences between polluted and unpolluted variants, registered under the same mineral and organic fertilization systems, during of observations are negative in the early years, the value of – 2.09 q/ha from 1997 is significant statistically, while in the last year (2002) it becomes positive, the value of + 1.45 q/ha was also significant statistically.

Organic fertilization leads in the last year of observations from distinct significant production increases of 2.51 q/ha, unpolluted version, only the highest dose of manure administered (150 t/ha) while production increases in polluted version are significant for the 100 t/ha manure (2,04 q/ha) and very significant (3.4 q/ha) for a maximum quantity administered.

If maximum doses of mineral fertilizers ($N_{200}P_{160}K_{140}$, $N_{300}P_{240}K_{210}$) leads very significant yield increases in both the version, the polluted and unpolluted, the lowest dose ($N_{100}P_{80}K_{70}$) determine statistically significant yield increases only for polluted variant.

The statistical processing of the average production in improvement polifactorial experience of soil polluted with 3 % crude oil, it was considered that the average annual yield of the seven years analyzed are seven repetitions (Table 1).

The analysis of average annual yields follows that only organic fertilization produced effects both variants polluted and unpolluted, the quantities of 100 and 150 t/ha manure causing the yield increases very significant.

*Table 1*

Average yields of spring wheat (1996-2002)

| Factor B | Factor C | | | | Sum B | Average B factor | Difference q/ha | Signifi -cance |
|---|---|---|---|---|---|---|---|---|
| | C0 | C1 | C2 | C3 | | | | |
| A0 Unpolluted | | | | | | | | |
| B0 | 10.68 | 12.77 | 14.50 | 14.95 | 52.89 | 13.22 | 0.00 | - |
| B1 | 12.41 | 13.94 | 15.39 | 15.62 | 57.35 | 14.34 | 1.12 | * |
| B2 | 14.04 | 15.37 | 16.78 | 17.00 | 63.19 | 15.80 | 2.58 | *** |
| B3 | 15.29 | 16.23 | 16.94 | 17.47 | 65.93 | 16.48 | 3.26 | *** |
| Sum C | 52.41 | 58.31 | 63.60 | 65.05 | 239.36 | 59.84 | | |
| Average C | 13.10 | 14.58 | 15.90 | 16.26 | 59.84 | 14.96 | | |
| Difference q/ha | 0.00 | 1.48 | 2.80 | 3.16 | | | | |
| Significance | - | - | - | - | | | | |
| A1 Polluted soil 3 % crude oil | | | | | | | | |
| B0 | 8.69 | 11.32 | 13.21 | 13.11 | 46.32 | 11.58 | 0.00 | - |
| B1 | 10.46 | 12.23 | 14.21 | 15.13 | 52.02 | 13.01 | 1.43 | ** |
| B2 | 12.91 | 14.73 | 16.28 | 16.02 | 59.93 | 14.98 | 3.40 | *** |
| B3 | 14.46 | 15.79 | 16.78 | 17.18 | 64.21 | 16.05 | 4.47 | *** |
| Sum C | 46.51 | 54.07 | 60.47 | 61.43 | 228.48 | 55.62 | | |
| Average C | 11.63 | 13.52 | 15.12 | 15.36 | 55.62 | 13.91 | | |
| Difference q/ha | 0.00 | 1.89 | 3.49 | 3.73 | | -1.06 | | |
| Significance | - | - | - | - | | | | |
| | | SDL | | 5 % | | 1 % | | 0,1 % |
| | | A x A | | 11,12 | | 16,84 | | 27,06 |
| | | B x B | | 1,03 | | 1,38 | | 1,82 |
| | | C x C | | 18,02 | | 23,75 | | 30,48 |

Production gains are higher for manure administered on polluted version. At the dose of 50 t/ha manure administered the production gain in unpolluted version (1,12 q/ha) is statistically significant and in the polluted variant (1,43 q/ha) distinctly significant.

**CONCLUSIONS**

Evolution of spring wheat yields in the study years had a decreasing trend in all variants, except for 1999, when they were higher in the organic and mineral fertilized variants and unpolluted variant.

The analysis of average annual yields shows that only organic fertilization affects both variants polluted and unpolluted, in quantities of 100 and 150 t/ha manure causing the yield increases very significant.

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