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ASSESSMENT OF THE PRESENT STATE OF A PROBLEM WITH DDT ON THE TERRITORY OF REPUBLIC OF BULGARIA

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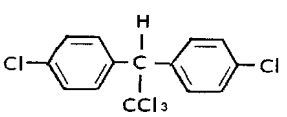
Abstract. A negative effect of DDT on human health and environment is the main subject of the present paper. The assessment shows that the country has already done the necessary measures for restriction of impact. The next steps are aimed at import of the agriculture production from the countries with unadjusted usage of DDT.

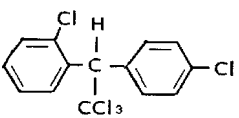
Keywords: pesticides, DDT, soil pollution with DDT.

AIMS AND BACKGROUND

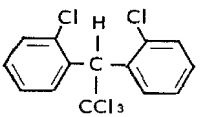
Diphenyldichlorotrichloroethane (DDT) is a synthetic chloro-organic insecticide belonging to the group of halogen aromatic compounds. The structural formula of its best known three isomers are as follows[1]:



p, p'-DDT

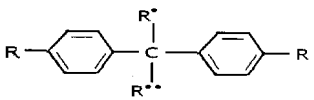


o, p-DDT



o, o'-DDT

The technical product DDT contains mainly 63-77 % of *p,p'*-DDT; 8-21% of *o,p*-DDT and 0.1-1% of *o,o'*-DDT. The empirical formula of DDT is as follows: $C_{14}H_9Cl_5$ Structure of *p,p'*-DDT and its analogues is of the form[2]:



The DDT production reached its maximum in 1963, when 800 000 mln t were produced in the world, including 100 000 mln t in USA. In 1974 the world production is less than 60 000 mln t (Ref. 3), due to the ban of DDT, as a result of big scale studies of its harmful impact on human health and environment

following its usage. The DDT usage in Bulgaria is banned since 1969 (Ref. 4). Nowadays, according to the Stockholm convention, the usage of DDT in agriculture is banned in all countries.

The aim of investigations in the present paper is to establish the actual state concerning the local pollution of soils with DDT in Bulgaria for the period of 1997-2001 as a result of illegal usage of DDT from residual unsold quantities and placers.

EXPERIMENTAL

Data about DDT contents for the period of 1997-2001 in the soils of intensively treated agricultural lands during 50's of the last century in 27 districts of Bulgaria are elaborated and presented in the present paper. The soil samples were analysed by gas-chromatography, according to the method ISO/CD 10382.2. The assessment of soil polluting with *o,p*- and *p,p'*-isomers of DDT, DDE and DDD was made according to the norms in Regulation No3 for admissible content of harmful substances in the soil[5]. The following norms are into force for DDT{total}: prevention level of concentration {PLC} – 300 μg/kg; admissible concentration limit {ACL} – 1500 μg/kg; interventional level of concentration {ILC} – 4000 μg/kg. Application of measures for purification of soils is necessary when the ILC is exceeded.

RESULTS AND DISCUSSION

Data for concentration of *o,p*- and *p,p'*-isomers of DDT, DDE and DDD are shown in Figs 1-19. The following results are obtained for the remaining districts: not any exceeding of the norms is observed in the district of Kardjali. In the city of Sofia, according to the data for 1999 the average annual content of DDT {total} is 254.32 μg/kg. Exceeding of the norms is established for soils in the Kremikovtsi municipality – Chelopechene and Botunets. The average annual content of DDT{total} for the district of Smolian is comparatively high – 668.10 μg/kg, exceeding PLC. Exceeding of ACL is found for Madan. *p,p'*-DDE and *p,p'*-DDT are prevailing. The data for 2000 show that for the district of Russe all *o,p*-isomers as well *p,p'*-DDD are under the detection level. In the district of Razgrad for 2000 *o,p*-DDE, *o,p*- and *p,p'*-DDD are not observed. The remaining *p,p'*-DDE shows a negligible prevailing over *p,p'*-DDT. The average annual content of DDT{total} is 120.03 μg/kg. Not any exceeding of the norms is observed in the district of Pernik. In 2000, the average annual content of DDT{total} is 182.79 μg/kg. An exceeding of PLC is registered for the soils of the Radomir municipality, village of Kosacha. The results for prevailing of *p,p'*-DDE and *p,p'*-DDT are analogues to those for 1999. In the district of Kiustendil,

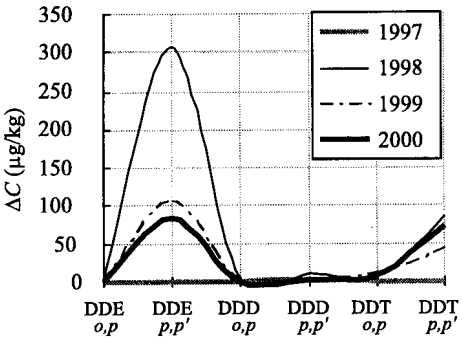


Fig. 1. Change of DDT-compounds concentration (ΔC) in the district of Plovdiv

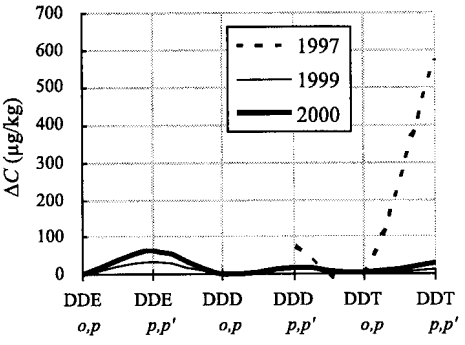


Fig. 2. Change of DDT-compounds concentration (ΔC) in the district of Montana

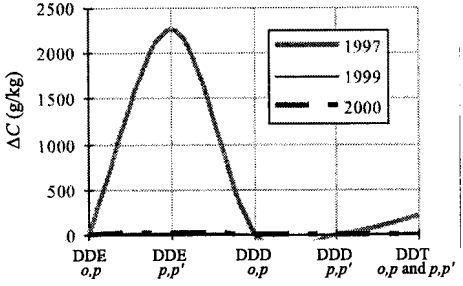


Fig. 3. Change of DDT-compounds concentration (ΔC) in the district of Vratsa

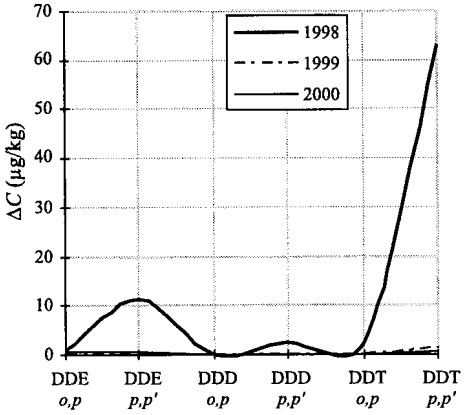


Fig. 4. Change of DDT-compounds concentration (ΔC) in the district of Varna

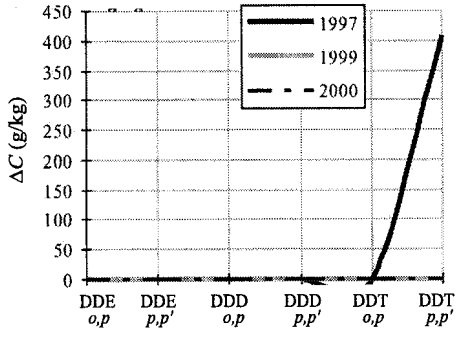


Fig. 5. Change of DDT-compounds concentration (ΔC) in the district of Veliko Tarnovo

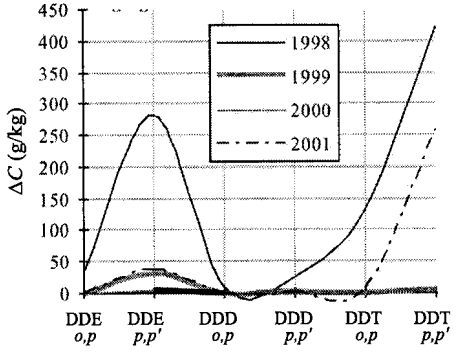


Fig. 6. Change of DDT-compounds concentration (ΔC) in the district of Stara Zagora

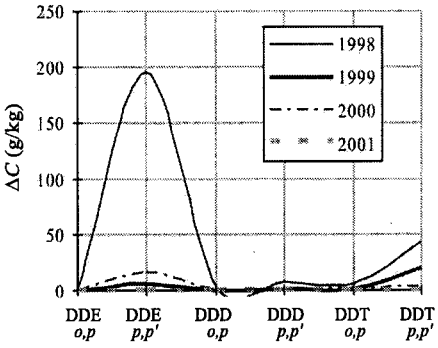


Fig. 7. Change of DDT-compounds concentration (ΔC) in the district of Yambol

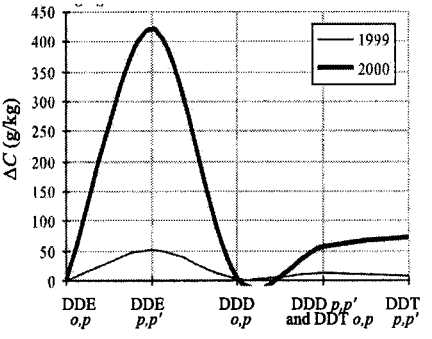


Fig. 8. Change of DDT-compounds concentration (ΔC) in the district of Blagoevgrad

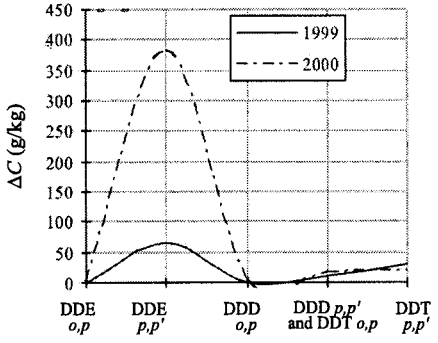


Fig. 9. Change of DDT-compounds concentration (ΔC) in the district of Sofia

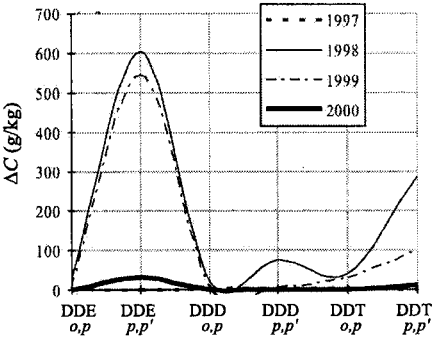


Fig. 10. Change of DDT-compounds concentration (ΔC) in the district of Pazardjik

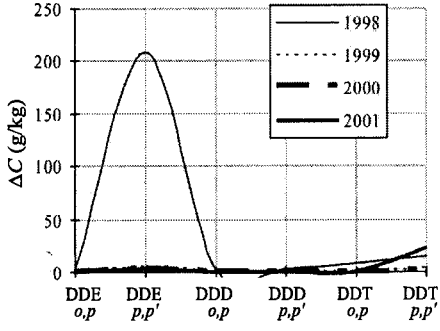


Fig. 11. Change of DDT-compounds concentration (ΔC) in the district of Sliven

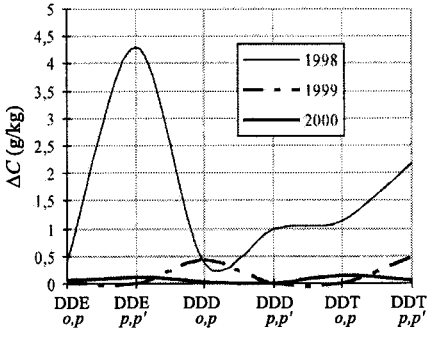


Fig. 12. Change of DDT-compounds concentration (ΔC) in the district of Pleven

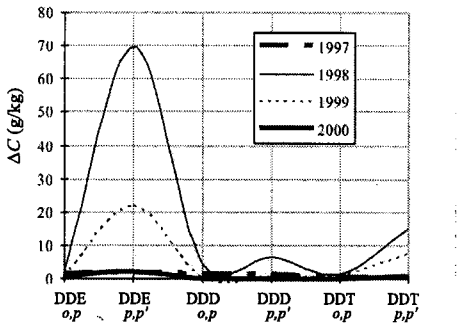


Fig. 13. Change of DDT-compounds concentration (ΔC) in the district of Haskovo

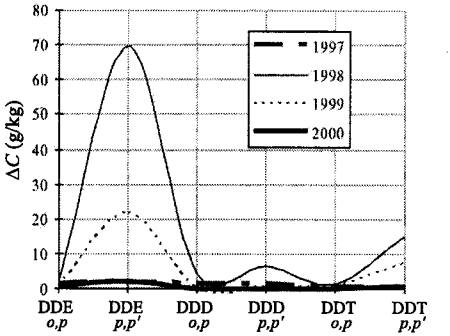


Fig. 14. Change of DDT-compounds concentration (ΔC) in the district of Dobrich

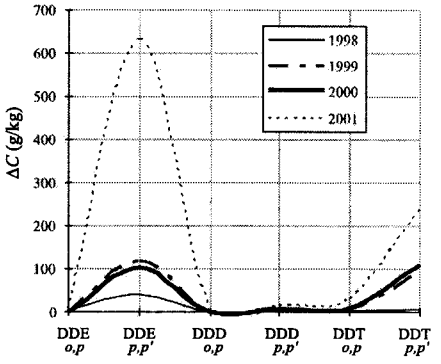


Fig. 15. Change of DDT-compounds concentration (ΔC) in the district of Burgas

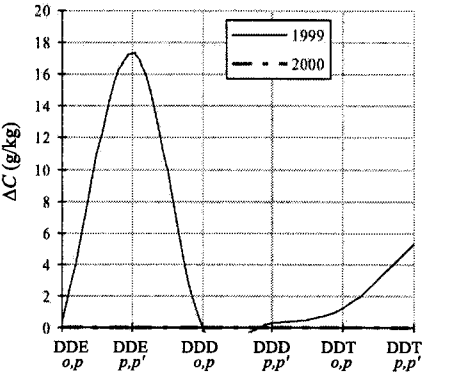


Fig. 16. Change of DDT-compounds concentration (ΔC) in the district of Gabrovo

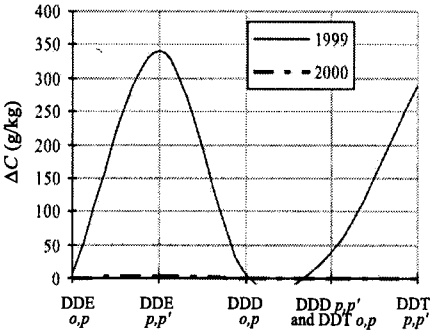


Fig. 17. Change of DDT-compounds concentration (ΔC) in the district of Vidin

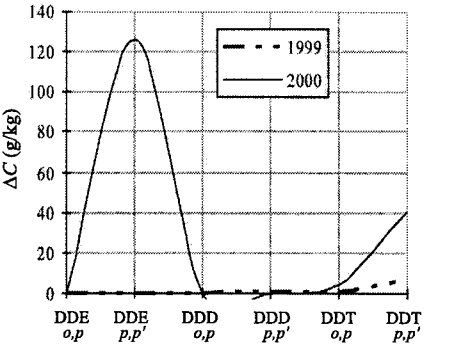


Fig. 18. Change of DDT-compounds concentration (ΔC) in the district of Silistra

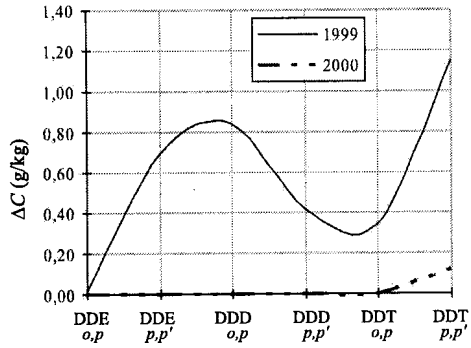


Fig. 19. Change of DDT-compounds concentration (ΔC) in the district of Lovech

Table 1. Chemical names of *p,p'*-DDT analogues

Name	Chemical name	R	R•	R••
DDT	1,1-bis(4-chlorophenyl)-2,2,2-trichloroethane	–Cl	–H	$-CCl_3$
DDE	1,1-bis(4-chlorophenyl)-2,2-dichloroethylene	–Cl	non	$=CCl_2$
DDD (TDE)	1,1-bis(4-chlorophenyl)-2,2-dichloroethane	–Cl	–H	$-CHCl_2$
DDME	1,1-bis(4-chlorophenyl)-2-chloroethylene	–Cl	non	$=CHCl$
DDMC	1,1-bis(4-chlorophenyl)-2-chloroethane	–Cl	–H	$-CH_2Cl$
DDNE	1,1-bis(4-chlorophenyl)ethylene	–Cl	non	$=CH_2$
DDOCh	2,2-bis(4-chlorophenyl)ethanol	–Cl	–H	$-CH_2OH$
DDA	2,2-bis(4-chlorophenyl)acetic acid	–Cl	–H	–C(O)OH

data for 2000 for the town of Dupnitsa show presence of all DDT-compounds, as the concentration of DDT{total}is 704.78 μg/kg, or exceed PLC. It is a result of increased content of *p,p'*-DDE, followed by *p,p'*-DDT. Not any exceeding of the norms is observed in the district of Targovishte. Data presented can be summarised and the following tendencies for content of DDT-compounds in soils of Bulgaria can be established:

• In 1997 exceeding of ILC is found only for Mizia (district of Vratsa). Exceeding of ACL is observed in the districts of Montana (Azasdjiiski dol) and Vratsa. Exceeding of PLC is found for the district of Veliko Tarnovo (Djuliunitsa).

• In 1998 exceeding of ILC is registered in two districts – Stara Zagora and Smolian. Exceeding of ACL is found in three districts – Stara Zagora, Pazardjik and Smolian. Content over PLC is observed in the districts of Pazardjik, Haskovo, Stara Zagora, Yambol and Plovdiv.

• Not any exceeding of ILC is found for 1999. Exceeding of ACL is observed in the districts of Vidin, Pazardjik and in the city of Sofia. Exceeding of PLC is reported for the districts of Burgas,Vidin, Sofia and for the city of Sofia.

• Not any exceeding of ILC is found for 2000. Exceeding of ACL is observed in the district of Blagoevgrad. Exceeding of PLC is reported for the districts of Montana, Russe, Razgrad, Pernik, Kiustendil, Burgas, Silistra and Plovdiv.

• Not any exceeding of ILC and ACL is found for 2001. Exceeding of PLC is observed in the districts of Burgas and Stara Zagora.

Not any exceeding is observed in the districts of Pleven, Lovech, Dobrich, Gabrovo, Varna, Targovishte, Sliven and Kardjali for the whole period. The correlation between different DDT-compounds is changeable, probably due to the carrying out of some transformations.

A clear tendency for decreasing content of DDT-compounds in the soil exists, probably as a result of the fact that *o,p*-DDT takes part in the self-destructive reactions easier than *p,p'*-DDT (Ref. 6). It is confirmed by the fact that chemical substances, where only one *p*-position is substituted with Cl, are destructed easier by the microorganisms in the soil in comparison with the substances wih two substituted Cl atoms on *p,p'*-positions. The results received in the districts of Plovdiv, Veliko Tarnovo, Stara Zagora, Sofia,Vidin, Montana probably are a consequence of illegal local usage of DDT, sampling in places near to the former warehouses for DDT, etc. The data confirm some investigations[7], according to which the soils of all treated by DDT regions contain even nowadays DDT and DDE, nevertheless that DDT is not in use since 30 years. The strong sorption capacity of the soils is a reason for similar statement. It is supposed that DDT in soils possesses a period for half-decay to DDE – more than 10 years, and DDE can be present in environment for more than 90 years. A tendency for decrease of quantities of DDT {total} in the soils exists for Bulgaria.

CONCLUSIONS

The investigations made on the soil pollution with DDT show that not any danger from increased content of DDT exists for human health and for environment. A tendency for decreasing the concentrations of DDT-compounds in soils is observed for the period of 1997-2001 as a result of physical-chemical transformations of these compounds. The measured concentrations in 2001 are under ACL and only in single cases – over PLC. Nevertheless, the presence of residual quantities of pesticides with not clear composition, which can contain DDT composition, determines a potential risk for pollution of environment. To prevent illegal usage of pesticides, containing DDT, is necessary annually to actualise the quantities of plant protection preparations unsold and with expired terms, with special attention to the residual quantities from the last century in private farms.

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