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GROUP POLYCHLOROPINENE POISONINGS AT MANUAL CULTIVATION OF SUGAR BEET

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Introduction

Sharp expansion of sugar beet production in the former USSR in the 1970-ies was based not so much on agrotechnics, but rather on the organochlorine pesticides (polychloropinene, toxaphene, hexachlorocyclohexane etc) and manual labour.

The demand for these organochlorine pesticides (OCPs) in general was met directly by the USSR's industry. Polychloropinene (strobane) was being produced in the town of Chapaevsk in a Plant of chemical fertilizers (Samara region) in 1957-1971, and also in Dzerzhinsk in a plant "Kaprolactam" (1965-1976). Some 43 thousand metric tons of polychloropinene were produced in a plant in Chapaevsk. Toxaphene was being produced in a plant in Chapaevsk in 1965-1987, 48 thousand metric tons were made. Polydophen (mixture of DDT and toxaphene) was being produced in 1968-1982 in Chapaevsk, the total output was 44 thousand metric tons.

Unrestrained use of polychloropinene, toxaphene and HCH in the agriculture led to serious health problems. Unfortunately the causes of numerous poisonings were not generalized.

Acute group poisonings

Circumstances of 11 cases of acute group polychloropinene poisoning of people working in sugar beet fields in various regions of Ukraine, are described in reports practically inaccessible to scientists[1-3].

A list of 7 cases of an acute group poisoning of farmers which happened in 1971-1974 in different collective farms of Nikolaev region, is given in report[1]. The total number of victims is 339.

Two cases of poisoning were "standard":

- May 14, 1971. 154 collective farmers began their work in a sugar-beet field 1 hour after it had been processed with polychloropinene, the acute poisoning happened immediately,
- May 20, 1971. 52 collective farmers started working in a field 12 hours after it had been sprayed with polychloropinene.

As the authorities knew beforehand that the workers sent by them to those fields will not return healthy, these 206 persons fell victims to the obvious cause.

The following 5 cases were not anticipated (previous experience showed that acute poisoning did not occur 11 days after toxaphene and polychloropinene processing[4]):

- In the summer of 1972 on the 14-th day after a field was processed with polychloropinene it was fertilized by ammonia water; 27 collective farmers, who worked the next day after the fertilazation (15-th day after spraying by polychloropinene), were poisoned immediately;
- April 25, 1972 the field was processed with polychloropinene and 33 collective farmers, working in it from May 5 to May 21, did not complain about the conditions; on May 22, 2-3 hours after the wind brought a cloud of amine salt herbicide 2,4-D from a nearby field, all 33 persons got symptoms of an acute poisoning,
- May 1, 1972 the sugar-beet field was processed with polychloropinene; 70 persons who worked in this field on the 10th day after spraying had no complaints; on May 20 the field was fertilized with carbamide, and the night after it the rain occurred; 8 members of a brigade of 70 collective farmers, who were in the field on May 21 (that is on the 21-th day after processing a field with polychloropinene), received acute poisoning after 1-1.5 hours of work,
- May 1-2, 1974. The field was processed with polychloropinene, on May 15-25 collective farmers worked in it and did not report any problem; between May 30 and June 6 the field was fertilized with ammoniac saltpeter, it rained on June 8; all 57 collective farmers who worked in this field on 11 June from the morning developed by 14 o'clock symptoms of acute poisoning,
- One sugar-beet field received particularly extensive treatment: on March 20, 1974 it was subjected to processing with superphosphate and potash fertilizer, on April 4 with hexachlorocyclohexane, on May 1 with trichlorphon, on May 2, 1974 with polychloropinene; on 12 May, 32 collective farmers arrived in the field and immediately began to complain about their health, they were found to be acutely poisoned.

The last 5 cases show, that, in chemical processes, polychloropinene participates together with fertilizers directly in the field.

One more case of an acute group polychloropinene poisoning in a sugar-beet field took place near Vinnitsa[2]. The symptoms of poisonings, reported on the seventh day after pesticide was used, were not characteristic for polychloropinene action and indicated that there exist new factors that lead to formation of new toxic substances. Mineral fertilizers brought into soil and high humidity of air also play their part.

Three cases of acute group poisoning took place in the mid-70s on sugar-beet fields near Kiev after their processing with polychloropinene[3]. The first case was "standard": workers were sent to do weeding just 2,5 hours after the processing and their poisoning was inevitable. However, the second and third cases happened 8 and 28 days after the last processing, when acute poisoning was no longer expected by the hygienic science.

New toxicants

In the majority of the described cases the concentration of polychloropinene in the air could no longer cause acute poisoning. Therefore it was necessary to identify other toxic compounds. Already some assumptions are available.

It should be stressed, that during transformations of polychloropinene and mineral fertilizers in the environment various toxic gases are formed (phosgene, carbon oxide, hydrogen fluoride, nitrogen oxides and other)[1]. Thus, poisoning is a result of combined action of these compounds[1].

phosgene **chlorcyan**

Report[3] mentions an unexpected toxic compound, chlorcyan, a battle toxic chemical of the WW I.

The concentration of chlorcyan in atmospheric air in sugar-beet fields near Kiev, where there were three cases of group poisonings, was as follows: 0.6 mg/m^3 after the first case, 0.46 mg/m^3 after the second, 0.25 mg/m^3 after the third. After the second case, phosgene, another toxic chemical of the WW I, was detected (in concentration 0.26 mg/m^3)[3].

Unequivocal answer to the question about the origin of chlorcyan was not given, a few hypotheses 3 were proposed.

Water aerosols

In some of the described cases of a poisoning one of the real factors could be high humidity of air. This was realized after the analysis of numerous cases of acute group poisonings of people in Ukraine by polychloropinene[5].

It is known, that pesticide aerosols, formed as a result of condensation of their vapour on the surface of tiny water drops, are more toxic in comparison with the vapour of the same pesticides. This circumstance turned out to be extremely important.

Table. Danger of pesticides, adsorbed on a fog drops[5]

Total surface of a fog drops in 1 m^3 of air (m^2)	Quantity of adsorbed pesticides, mg/m^3	Hygienic standard for the atmosphere, mg/m^3	Factor of excess of hygienic standard
0.3	2.9	0.03	**97**
1.5	14.78		**493**
3.14	30.9		**1030**
4.2	41.4		**1380**
6.28	61.95		**2065**

The table gives an idea about the level of danger in the cases, when enthusiasts of large application of OCPs do not take into account the role of such a factor, as humidity of the air. As polychloropinene is not an individual substance, but rather a mixture of many substances, the data[5] for individual OCP, hexachlorocyclohexane, is shown. It is evident, that, if the diameter of fog drops is 2 microns, the total surface of drops in 1 m^3 of air can reach 6.28 m^2. Accordingly, a thousandfold excess of safe levels can be reached, which was not predicted by the physical laws known for ideal gases.

It is clear, that in a large number of cases the rain in the area of usage of OCPs and other pesticides is a direct guarantee of misfortune. Even in the case of "absolutely nontoxic pesticides". And this is because the concentration of real pesticides in the air can be thousands and millions times higher than it is permitted by the Mendeleev-Klapeiron law established for ideal gases without taking account of real conditions. The dangerous situation can be "preserved" by weather conditions in the site where the pesticides are used. It is only required that the speed of the wind be close to calm, and temperature in a layer of air near ground be inversed.

Unfortunately, it is practically impossible to predict toxic fog. Thus, we must be prepared to have this phenomenon in future.

Conclusion

The information on the acute group poisoning by polychloropinene has not become property of the society. A ban on polychloropinene usage in the agriculture in the former USSR was implemented in two stages, partially in 1978 and completely only in 1981. Presently the reports[1-3] are not accessible even to the experts.

Negative experience described in the reports[1-3], in view of work[5], cannot be regarded as out-of-date. It is still urgent today and should be taken into account in the future.

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