

## Experiments on Lindane Metabolism in Plants IV. A Kinetic Investigation

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In recent publications the formation of HCB (STEINWANDTER 1976 a, STEINWANDTER 1976 b) and  $\alpha$ -HCH (STEINWANDTER 1976 b, STEINWANDTER 1976 c) from lindane has been described as well as the formation of  $\beta$ -HCH (STEINWANDTER 1977, STEINWANDTER 1976 b). However there is no information about

- 1) the kinetics of the lindane metabolism and
- 2) the specific conditions involved therein.

Both items will be discussed in the following chapters.

1) At first the question arises whether HCB and  $\alpha$ -HCH are formed in a consecutive reaction (Figure 1) or in a parallel reaction (Figure 2) from lindane. To distinguish between these two possibilities, a grass sample, contaminated with  $\alpha$ -HCH was processed in regular intervals of three weeks (STEINWANDTER 1977, STEINWANDTER and BUSS 1975) and analyzed gas chromatographically and by mass-spectroscopy. Although these tests were performed over a period of 10 months, no HCB formation from  $\alpha$ -HCH could be detected.

This demonstrates, that HCB and  $\alpha$ -HCH are formed from lindane in a parallel reaction (Figure 2). Since  $\alpha$ -HCH was converted into  $\beta$ -HCH (STEINWANDTER 1977) and not into HCB the lindane metabolism is assumed to follow the scheme shown in Figure 3.

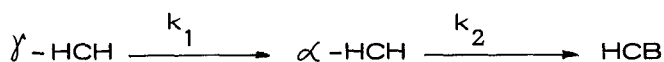


Figure 1. Degradation scheme of lindane via a consecutive reaction

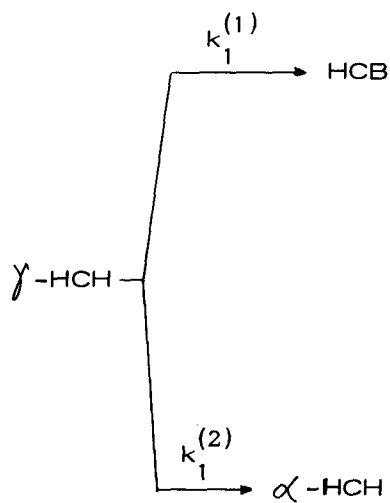


Figure 2. Degradation scheme of lindane via a parallel reaction

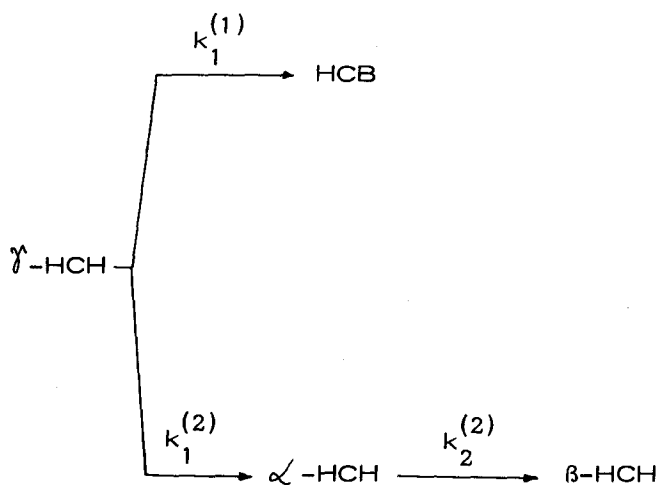


Figure 3. Experimental results of the lindane degradation

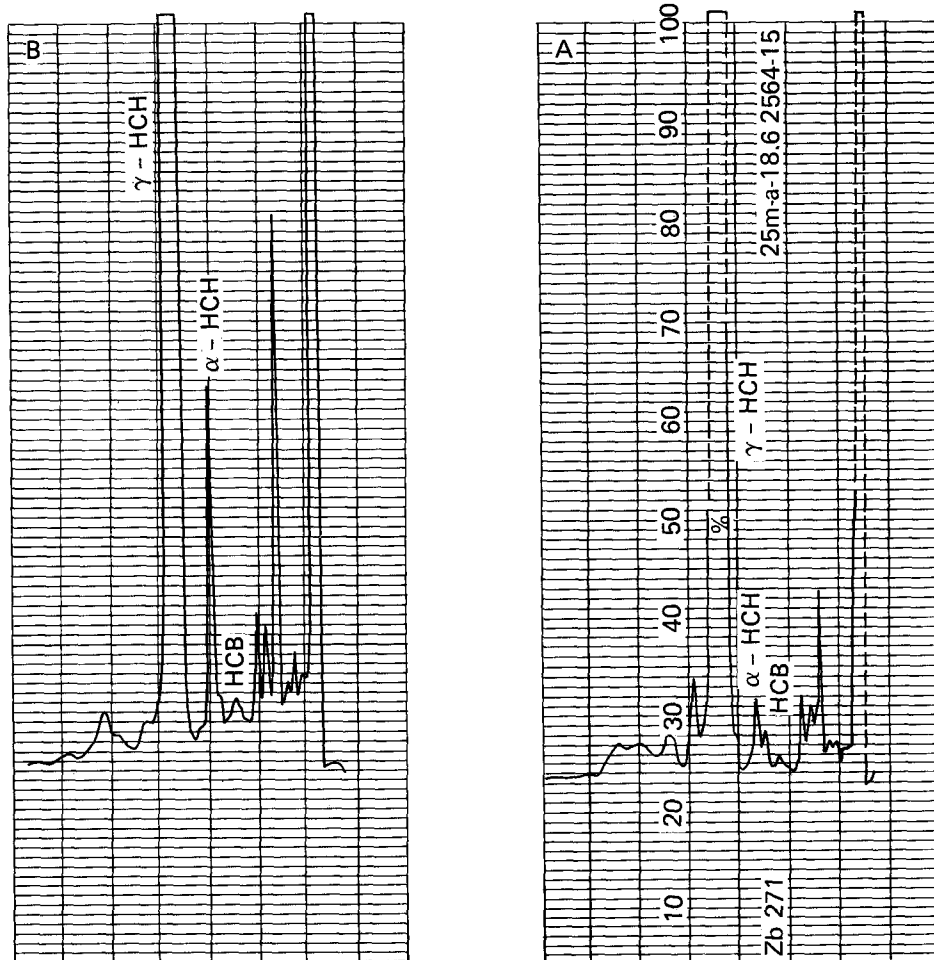


Figure 4.  $\alpha$ -HCH formation from lindane in an open field. Gas chromatograms of the lindane contaminated grass sample after two (Figure 4 A) and seven (Figure 4 B) weeks.

2) Actually there is no information about the values of the rate constants  $k_1^{(1)}$ ,  $k_1^{(2)}$  and  $k_2^{(2)}$ , because the exact conditions for the conversion of lindane into HCB and  $\alpha$ -HCH and  $\beta$ -HCH respectively are not known. A striking example for this situation are the results for the rate constants  $k_1^{(1)}$  and  $k_1^{(2)}$  of HCB and  $\alpha$ -HCH formation from lindane, which were obtained from a lindane contaminated grass sample. The sample was divided in two halves. One half was kept on a open field, the other half in a closed room. So that the room sample could see the same temperature changes as the open field sample, the room temperature was allowed to follow the field temperature.

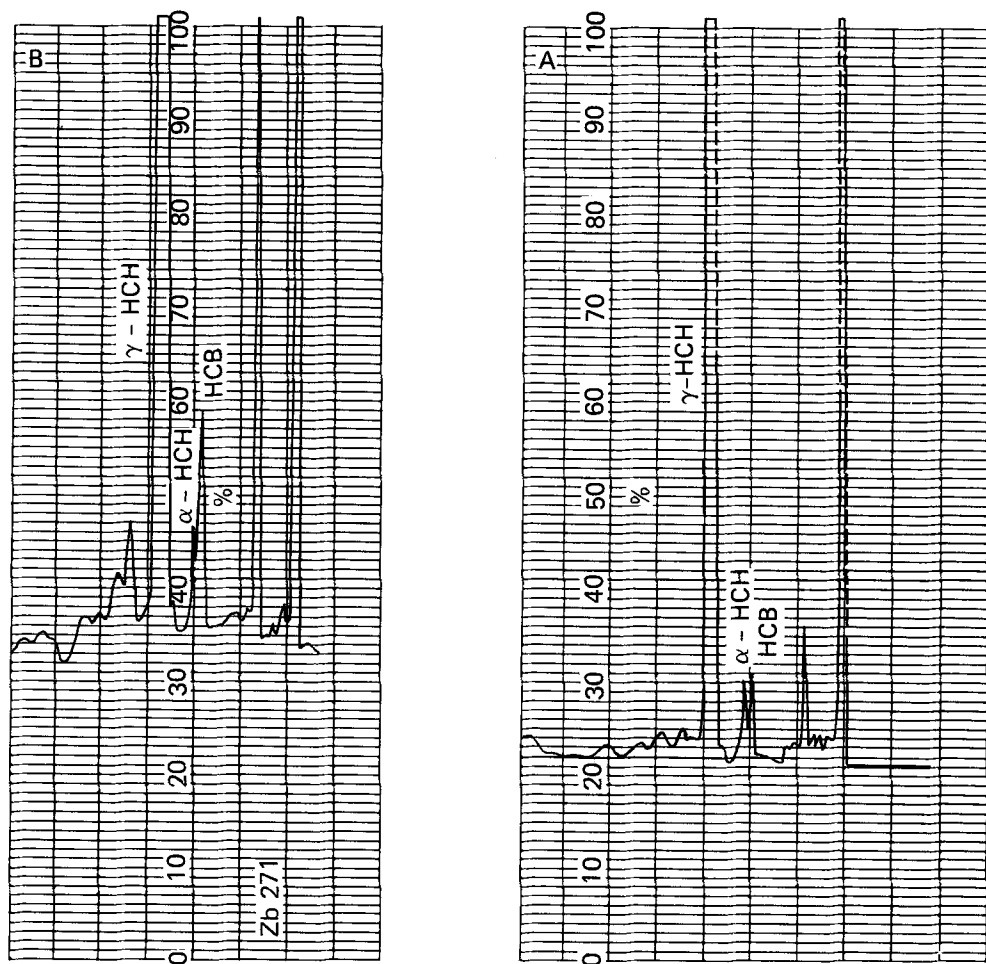


Figure 5. HCB formation from lindane in a closed room. Gas chromatograms of the lindane contaminated grass sample after two (Figure 5 A) and seven (Figure 5 B) weeks.

The chromatograms of those samples kept in the open field a processed after two (Figure 4 A) and seven weeks (Figure 4 B) are shown in Figure 4. According to Figure 4 the formation of  $\alpha$ -HCH occurred by far faster than that of HCB.

In contrary, HCB was formed much faster than  $\alpha$ -HCH in the closed room, as shown in Figure 5. This samples also were processed after two (Figure 5 A) and seven (Figure 5 B) weeks.

Similar differences as in the formation of HCB and  $\alpha$ -HCH from lindane were observed in the formation of  $\beta$ -HCH from  $\alpha$ -HCH. In this experiment the formation of  $\beta$ -HCH suddenly started after a short reaction time (induction period). The  $\beta$ -HCH concentration reached its maximum value in the grass sample at the end of the reaction time (induction period). Due to the evaporation (STEINWANDTER 1976 d, STEINWANDTER and SCHLÜTER 1977 , SCHLÜTER and STEINWANDTER 1976 ), the  $\beta$ -HCH concentration decreased continuously after the ending of the formation reaction.

These results demonstrate the problems and difficulties one encounters in the reproduction of ecological reaction conditions. Presently the exact standard conditions of latent (SZABO 1961) and induction (SZABO 1961) period are not known for the microbic or enzymatic lindane metabolism. However the results of the above described experiments clearly show, that considerable quantities of HCB,  $\alpha$ -HCH and  $\beta$ -HCH can be formed from lindane and are found in the environment in addition to the amounts of HCB,  $\alpha$ -HCH and  $\beta$ -HCH released by industry.

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