Action of Herbicides and Insecticides on the Photosynthetic Apparatus

Preface

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In the fifties chemical pest control was established in the agriculture of the Western countries. Together with the mechanization of farm production, extended crop areas and monoculture, as well as the increased use of fertilizers, herbicides helped to revolutionize agriculture and to raise productivity tremendously. Under the current conditions of the Western markets and their cost of labour, there is no satisfactory substitute for herbicides in efficient farming. Untreated grain or sugarbeet fields are an exception in Germany.

This situation requires more effective and selective chemicals which allow a reduction of their doses, a better control of annual grasses and less susceptible broadleaf weeds, able to cope with genetic resistance and which have a better matching to different soils and climates. Furthermore, the distribution of species within a weed population is shifted by long-term application of a certain herbicide type, *e. g.* growth-promoting substances. Newly developed phytotoxic compounds will solve many of these problems. In addition, crops like soybeans are now present in areas where they were not grown before, again demanding new products. Leglislative amendments and regulations have an impact on the improvement of chemical pest control.

To obtain a new phytotoxic agent one must first determine whether a substance interferes with plant metabolism, and a prerequisite for future herbicide development is to know more details about biological reactivity. Without the study of possible sites of herbicidal attack in the cell and in organelles the finding of reactive compounds is definitely a hazard. Concurrently, is it mandatory to use more refined assays including cell-free systems supplementing the conventional greenhouse-screening test.

The most important herbicides recently developed attack the photosynthetic apparatus and many experimental compounds not yet introduced into the market also aim at this typical plant process.

Studies as to how adequate chemicals interfere with photosynthetic reactions in cellular and cell-free systems were presented and discussed at a meeting held in March 1979 in Konstanz, Germany. The Zeitschrift für Naturforschung deserves thanks for publishing the contributions in this special issue. Although the papers had to be abridged, they should reflect the recent state of basic research in the field of pesticides acting upon the photosynthetic electron transport and pigment system.

The first articles give a survey of the general problem, the following ones deal with the physiology of herbicide action on higher plants and algae (Section II). Algae in particular have been found to be advantageous model systems for obtaining information on the herbicidal primary mode of action and the subsequent disturbances of chloroplast functions. The papers of Section III deal with biochemical aspects while Section IV presents data on herbicide influence upon redox reactions. The photosynthetic electron transport system is undoubtedly still the great domain for the attack of new chemicals and of those already introduced into modern weed control, although definite knowledge about the functional details is just emerging. Section V deals with "bleaching herbicides", the importance of which will certainly increase in the future. The articles following at the end present some aspects of insecticide interaction with the plant system.

Apparently, many phytotoxic compounds react quite specifically with certain components of the photosynthetic redox chain. Our knowledge accumulates concerning different sites of the thylakoid membrane which bind different herbicides according to their chemical structure. Structure/activity relationships help the chemist to decide how a given substance should be modified or other compounds synthesized to improve their efficiency and fulfill other demands of modern plant protection. Further-

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more, some herbicides are quite specific tools to achieve limited quantitative changes of the chloroplast inventory during growth (as *e. g.* carotenoids or lipids) which can be compared with electron transport activity. This allows certain conclusions on the role of essential components. So the investigations presented here contribute to basic research and to the functional understanding of the photosynthetic process.

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