THE USE OF BIBLIOMETRIC INDICATORS IN THE STUDY OF INSECTICIDE RESEARCH

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This paper reports part of a historical study of insecticide development. We analysed accumulated references to specific insecticide groups in text books, and index references to a large number of specific insecticides in the Review of Applied Entomology (Ser. A) over the period 1916–70. The paper describes our techniques for analysing the resulting research publication growth curves for these compounds. Our data did not fit the “classical” S-curves, and possible explanations for this are discussed. Bibliometric time series data may exhibit various inconsistencies, and we describe an approach to handling such “dirty data”. We concluded that; our quantitative approach produces a picture of the development of insecticides that fits the accepted view derived by qualitative historiography, is very sensitive to trends in pesticide research, and might be a useful adjunct to technology forecasting as well as to historical studies.

Introduction

This paper offers support for the view that historical studies of science and technology can only benefit from a judicious use of quantitative analysis. It reports only a small part of a long-standing project on the historical development of R & D in economic entomology.1 This paper does not enter the basic debate on the utility and validity of quantitative methods in the history of science and technology2 as such, but rather reports on the uses of such analyses.

Major stages in insecticide research

Insecticides are chemical compounds that are used to kill insects. More than 500 compounds, in several thousand formulations, are presently available,3 however, a relatively small number of these dominate research and practice.

Although insecticides have been used since ancient times4 it is only since the mid 19th century that they have been manufactured and used regularly on any scale.
Table 1
Stages in the history of insecticides research based on historical reviews

1. Pre-1889
   Tendency to draw upon herbal sources and upon compounds known to human toxicology, eg. compounds of
   arsenic, lead and copper — many of which were already produced in bulk as paint pigments, eg. Paris Green
   (a mixture containing copper acetoarsenite) and London Purple (a mixture containing arsenate and arsenite of
   copper).

2. 1890—1899
   Paris Green and London Purple reach their historical maximum use. Now find in use; pyrethrum, hellibore, whale
   oil, soaps, kerosene emulsion with soaps, flowers of sulphur, carbon disulphide, cyanide gas, lime sulphur and
   lead arsenate. 7

3. 1900—1909
   Full establishment of latter two compounds as the most important. 8

4. 1910—1919
   Introduction of calcium arsenate, zinc arsenate, sodium fluoride, nicotine sulphate. 9

5. 1920—1929
   Few compounds, but refined oil emulsions, lead arsenate, pyrethrum and nicotine products were well established.

6. 1930—1939
   Calcium arsenate, pyrethrum, and derris dominate, but a new research current develops — the search for synthetic
   organic insecticides, 10 which was to bear fruit in the next decade.

7. 1940—1949
   This was the “heroic decade,” 11 the “Golden Age” 12 of insecticide research which produced:
   (a) Organochlorine, compounds; DDT, BHC, toxaphene, chlordane, aldrin, dieldrin and endrin.
   (b) Organophosphorus compounds; parathion, schraden, etc.
   (c) Synthetic pyrethrum, eg. allethrin.
   (d) Synergists, which increase the toxicity of scarce expensive compounds, such as pyrethrum, eg. piperonyl butoxide.

8. 1950—1959
   This saw two major developments:
   (a) Increase in the number and range of organophosphorus compounds in two directions:
      (i) development of systemic properties, eg. demeton
      (ii) development of low mammalian toxicity, eg. malathion.
   (b) Development of the carbamate group of insecticides, eg. carbaryl.

   The number of new organophosphorus and carbamate insecticides vastly increased. The isolation of substances
   controlling the growth and development of insects, eg. juvenile hormone opens the way for “third generation”
   insecticide. 13