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忌避剤と誘引剤の農薬としての価値の再発見(農芸化学科)

メタデータ	言語: English 出版者: 琉球大学農学部 公開日: 2008-02-14 キーワード (Ja): キーワード (En): 作成者: 小波本, 直忠, Kobamoto, Naotada メールアドレス: 所属:
URL	http://hdl.handle.net/20.500.12000/4368

Rediscovery of the Pesticidal Significance of Repellents and Attractants

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I INTRODUCTION

All scientists working in the field of pesticide chemistry realize a difficult problem of environmental contamination by the chemicals used for controlling insects, weeds, microbes, and others (4, 9, 19). Many of them are not only aware of this problem but also devote a significant fraction of their works for finding solutions to this problem. Even limiting to chemical means, a large number of promissing ways of solving the problem has been proposed in the past decades by these workers. Nevertheless, due to the complexity of our environment the present state of this field of investigation still needs the thought-provoking ideas generated for attacking this relatively old problem.

The purpose of this paper is to present a way of solving environmental contamination with pesticides by developing safe pesticides to both pests to be controlled and other living organisms. For a better understanding of the thesis presented in this work, we need to examine the basic concept of pesticides and the physicochemical properties of the chemical compounds to be used for controlling the pests in perfectly safe ways. We should realize that the means presented in this work is only one of the promissing ways for solving the problem of environmental contamination with pesticides, proposed in the past decades.

II FROM ERADICATION TO COEXISTENCE

It is very difficult to answer for the question what the present day concept of pesticide is, since under the word "pesticide" covered is a great number of the chemicals used for diverse purposes. Nevertheless, a large fraction of pesticides may be considered to be developed for the purpose of the eradication of the population of the pests to which they show bioactivities through their toxicity.

The problem of the present day concept of pesticide is the eradication of pest population itself. The screening techniques used for the development of today's pesticides ought to depend on the population of the pest being adapted to the present day local environment of the institute carrying out the screening. Unfortunately, the pest population has remarkable potentialities in its gene bank such that there always remain the extremely small

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Sci. Bull. Coll. Agr. Univ. Ryukyus, 21: 123~129 (1974)

fraction of the population, which can show a resistivity against the pesticide being under a screening test (3, 20). To overcome such a resistivity toward new pesticides in intervals of several generations, we need to develop other pesticides. The repetition of such a procedure may not necessarily lead to the eradication of this type of the pest population. At the same time the environmental contamination due to the accumulation of this type of pesticides cannot be neglected, since these pesticides in one way or another tend to destroy the life processes of living organisms, possibly, including human beings.

Then, one may ask what the concept of new pesticides should be. The new pesticides may not destroy any forms of life, being absolutely safe to living organisms. By satisfying this condition the new pesticides can become desirable for the view point of environmental contamination. The new pesticides also may not create the genetical selection but rather may generate the geographical selection. Such a way of controlling pest populations may be done only with the mild methods of population control, applied to the restricted geographical region of an economical interest.

Ⅲ NEW PESTICIDES

New pesticides may be termed as repellents and attractants in a broad sense of words. The development of modern chemical ecology showed that the living organisms communicate with their environment by a chemical means as they communicate among the members of the same organisms with pheromones. This type of chemical communication is universal in all living organisms (22), including insects (11), plants (15), and microbes (18). A use of repellents and attractants may help us communicate with these organisms without unnecessary destruction of life itself.

As far as the pesticidal uses of repellents and attractants are concerned, the present status of our knowledge is farely limited (1, 10, 16). Since works on insect pheromones showed an extream sensitivity of the olfactory receptors of insects (12), it is quite possible to find highly effective attractants and repellents in gustation and olfaction. For a field use of gustatory repellents, the coverge of protecting objects may not be complete. In such a case, an addition of the taste modifiers (14) which can be effective for a sustained time period and, furthermore, can be transferred from the gustatory receptors to the olfactory receptors. From this, it is expected that a traditional use of mere olfactory repellents may not be a desired pattern for the use of the new pesticides.

Although safety requirement can be satisfied, new pesticides may have genetical problems in a way slightly different from the traditional pesticides: There is a possibility of having "gustatory or olfactory blinds" to a certain repellent or attractant. Nevertheless, a combination of several

compounds may eliminate the drawback of this possibility. Moreover, since in a waste land remains an unaffected population, it is very likely that a use of repellents and attractants will not necessarily lead to the genetical discrimination of the pest population to be controlled.

For an effective use of new pesticides, repellents and attractants, a nation wide control project by public agencies is desired since the use of these chemicals in individual farms may create an intensive accumulation of the pests in other neighboring farms. At least, community level organization in the application of the new pesticides must be taken account. By doing, this, we can achieve the transition from the genetical discrimination to the geographical discrimination. At this time, it is worthy to mention that like all other bioactive chemicals the use of pesticides in this practice ought to be administered by a local government upto the level of actual application as pointed out by Edson (8).

Ⅳ MASS APPLICATION OF NEW PESTICIDES

When a mass application of new pesticides is carried out, organic pesticides may create BOD problems even with safe compounds. Since the ecological awareness is growing rapidly,, the development of organic pesticides need to be examined from this point of view. The problem may be solved in a large extent by a use of inorganic compounds.

In order to formulate inorganic compounds as new pesticides, the best source of the elements to be used must be soil, since the soil is a natural storage for the ' inactive forms ' of most living organisms although it cannot provide the major structural constituents and energy for life. The contents of the major elements which compose 98% of the soil are 47.3% in oxygen, 27.7% in silicon, 7.8% in alminum, 4.5% in iron, 3.5% in calcium, 2.5% in sodium, 2.5% in potassium, and 2.2% in magnesium (17) . Only one element out of eight elements does not fit for pesticidal uses : Alminum is shown to be toxic to plants (17) . Other elements are all secondary nutrients or micronutrients (6), being nonhazardous to environment : Their uptake and accumulation by the living organisms are regulated by metabolism. Moreover, these elements are abundant in nature.

The accumulation of active inorganic compounds in the environment would cause a problem. It is very desirable, if possible, that when the compounds are insoluble to water they may function as soil and when they are soluble to water they may function as pesticides. If the solubility is managed to be low enough not to affect the environment, the above compounds, by cyclic turnovers, can create the conservation of inorganic matter without accumulating the active forms in the environment. Examination of the ranges of soil pH should give various means for controlling the active inoic state of the elements in the nature.

What kind of physicochemical properties of inorganic compounds are desirable for new pesticides ? Since all basic modes of taste (sweetness, bitterness, saltiness, and sourness) can be induced by inorganic compounds, gustatory stimulations may be desirable. Taking even one of the simplest compunds like NaCl, its taste to man changes from sweet to salty (or salty and bitter) as the concentration of a solution increases. The complexity of the taste of inorganic compounds is so rich to have a good potentiality to be a type of the new pesticides. Since inorganic compounds generally have higher specific gravities, they would be gustatory stimulants rather than olfactory stimulants. Within the gustatory stimulation the repelling action would be aimed for the development of the new pesticides. The hydration of inorganic compounds must be studied for the development of the new pesticides since the formation of hydrogen bonds is considered to be one of the major processes in the induction of chemical senses (13).

The followings are the possible examples of inorganic new pesticides conceivable at the present. Iron is utilized as a commercial rapellent against various animals. Calcium has a repelling action (5) and has been used for the purpose of an insect control in a commercial scale. Magnesium may also function as a repellent in a similar manner to calcium because of its rejectiveness to insects (5). And silicon may be used as a repellent due to its physical actions such as blocking the pores of chemosensory hairs in spherical powder forms and forming thin films over the object to be protected in a linear polymer form and dust form (7).

There are possible disadvantages in using inorganic new pesticides. Atmospheric contamination with inorganic dusts in their application process may be eliminated by developing a proper pesticide formulation like a solution or an emulsion. Similarly aquatic contamination is possible but it may not be so dangerous since the solubilities of the inorganic compounds in water are relatively small and the compounds can form the complexes with many ions in the water easily, which can precipitate rapidly, leading to its removal from the water phase. Since as mentioned above the nature of these pesticides is in a strongly desirable form, their use should be considered as an ideal part of the integrated methods of pest control (21), Which use the various control methods dependent on the physical and biological principles (2) as well as the chemical principles.

REFERENCES

1. Ascher, K. R. S. 1970 Insect pest control by chemosterilants and antifeedants – Magdeburg 1966 to Milan 1969, Wld. Rev. Pest Control, 9 : 140 ~ 155
2. Beirne, B. P. 1962 Trends in applied biological control of insects, Ann.

Rev. Entomol., **7** : 387～400

3. Brown, A. W. A. 1961 The challenge of insecticide resistance, Bull. Entomol. Soc. Am., **7** : 6～19
4. Cope, O. B. 1971 Interactions between pesticides and wildlife, Ann. Rev. Entomol., **16** : 325～364
5. Dethier, V. G. 1963 The physiology of insect senses, p130～131, London, Methuen & Co. Ltd.
6. Donahue, R. L. Shickluna, J. C. and Robertson, L. S. 1971 Soils－an introduction to soils and plant growth, 3rd Ed., p13, Englewood Cliffs, Prentice－Hall, Inc.
7. Ebeling, W. 1971 Sorptive dusts for pest control, Ann. Rev. Entomol., **16** : 123～158
8. Edson, E. F. 1971 Pesticide toxicology－experimental, applied and regulatory, Wld. Rev. Pest Control, **10** : 24～30
9. Holcomb, R. 1970 Insect control : alternative to the use of conventional pesticides, Wld. Rev. Pest Control, **9** : 156～160
10. Jacobson, M. 1966 Chemical insect attractants and repellents, Ann. Rev. Entomol., **11** : 403～421
11. ———— 1972 Insect sex pheromones, p121～147, New York, Academic Press
12. Kaissling, K. E. 1971 Insect olfaction, Beidler, L. M. Ed., Handbook of sensory physiology, Vol. 4 Chemical senses, Pt. 1 Olfaction, p351～431, Berlin, Springer－Verlag
13. Kobamoto, N. 1974 A proposal for the physicochemical determination of the sweetness of sugars to man, Sci. Bull. Agr. Univ. Ryukyus, **21** : 131～136
14. Kurihara, K. 1971 Taste modifiers, Beidler, L. M. Ed., Handbook of sensory physiology, Vol. 4 Chemical senses, Pt. 2 Taste, p363～378, Berlin, Springer－Verlag
15. Leopold, A. C. 1964 Plant growth and development, p252～253, New York, McGraw－Hill Book Company
16. Martin, H. 1973 The scientific principles of crop protection, 6th Ed., p343～347, London, Edward Arnold Publishers Ltd.
17. Millar, C. E., Turk, L. M. and Foth, D. 1966 Fundamentals of soil science, 4th Ed., p95, 139, New York, John Wiley & Sons, Inc.
18. Naitoh, Y. 1968 Ionic control of the reversal response of cilia in *Paramecium caudatum*. a calcium hypotheses, J. Gen. Physiol., **51** : 85～103
19. Newson, L. D. 1967 Consequences of insecticide use on nontarget organisms, Ann. Rev. Entomol., **12** : 257～286
20. Ripper, W. E. 1956 Effect of pesticides on balance of arthropod populations, Ann. Rev. Entomol., **1** : 403～438

21. Van den Bosch, R. and Stern, V. M. 1962 The integration of chemical and biological control of arthropod pests, Ann. Rev. Entomol., **7**: 367～386
22. Whittaker, R. H. and Feeny, P. P. 1971 Allelochemics: chemical interactions between species, Science, **171**: 757～770

忌避剤と誘引剤の農薬としての価値の再発見

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要　　約

近年，農薬の公害と昆虫の農薬抵抗性発現が問題化しているが，これらは，農薬の持つ毒性と貴伝的スクリーニングに起因するものであり，新農薬は，これら二要因を持たない化学物質であることが要求されている。忌避剤と誘引剤は，毒性を持たず，地域的スクリーニングを達成し，理想的な農薬の一形態であり，さらに，有機物の大量使用による環境汚染を避けるため，地殻を形成する主要8元素の使用の可能性について考察し，アルミニウムを除く他の元素は，昆虫の忌避剤として利用価値のあることが明らかになったが，それらの実用化には，製剤化学的研究が，強く要求されているが，その進むべき一方向を示した。

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