招請講演
Invited Lecture

Agricultural Chemical Development: An Industry View[1)]

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企業의 農藥開發과 雜草防除[1)]

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Thank you Mr. Chairman. It is my pleasure to be with you at this Inaugural Meeting of the Korean Society of Weed Science. I am especially honored to be asked as guest speaker in this general session and to share the podium with Dr. Ahn. An assembly such as this reminds me of my membership attendance and participation in weed science meetings since 1967.

Before I begin my topic entitled "Agricultural Chemical Development: An Industry View," I wish to communicate some comments from the International Weed Science Society. When I first heard of the Korean Weed Science Society formation, I took the liberty to communicate this information to Dr. Marvin Schreiber, President of the International Weed Science Society. If you will allow me, I wish to convey his message.

In a recent letter to Dr. Ryang he said and I quote "Dear Dr. Ryang: On behalf of the executive committee of the International Weed Science Society, I congratulate you and your committee on the establishment of the Koean Society of Weed Science and on the convening of your inaugural meeting scheduled for June 27, 1981. We heartedly welcome you to the family of weed science societies."

"The I.W.S.S. does not wish or intend to compete with national or regional weed science societies but to supplement and coordinate the mutual interests of weed scientists. Weeds and their control do not respect national or regional borders."

Dr. Schreiber also extends some items of advice to the Korean Society of Weed Science:

1. Actively associate and affiliate with the Asian Weed Society.
2. Affiliation with the International Weed Science Society.
3. Encourage individual membership to I.W.S.S.
4. Communicate between the Korean Society and I.W.S.S. regarding meetings, membership lists, publications, and current information on officers and their addresses.

The International Weed Science Society, Dr. Schreiber, and I all wish you the best of success.

Now, I wish to turn to my subject for the day. There are many topics and lengthy discussions which could be discussed under the title of my presentation. Today, after a brief background, I will 1) review the costs, concerns, and constraints of chemical development, 2) briefly explore the future, and 3) provide some observations or challenges to you as a society and individual weed scientists.

The production of food in both quantity and quality to meet the ever-increasing population is a well-recognized fact by all who are committed to this task. These are people like you and me.

The famous Malthus Theory and population growth is well-known to all of us. Although I will not dwell on

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1) Presented at the 1st Inaugural Meeting of the Korean Society of Weed Science at Jeonju, Korea on June 27, 1981.

this subject, I do wish to share some recent interesting information. In an article in 1976 entitled "Six Billion People are Coming to Dinner in the Year 2000," Rodney J. Fee predicted that agriculturalists must increase production by 75% just to stay even with the population. Recently in Korea, it was suggested by a senior researcher of the Korea Rural Economics Institute that "Korea's grain consumption would increase by a whopping 71% during the 1979-2000 period." The forecast was based upon a predicted population of 50.6 million people by the year 2000 with 43.6 precent living in Seoul or Pusan. There is much similarity between these projections. These predictions on productivity requirements, population, and ratio of city dwellers to rural people illustrate the challenges which lie ahead.

Agricultural technology and crop protection methods such as herbicides contribute to a significant degree to meet the challenges for food. The availability of crop protection chemicals is one of the more remarkable achievements of modern technology. In many ways, it is an outstanding example of what can be accomplished by a cooperative effort among industry, academic institutions, government agencies, and farmers.

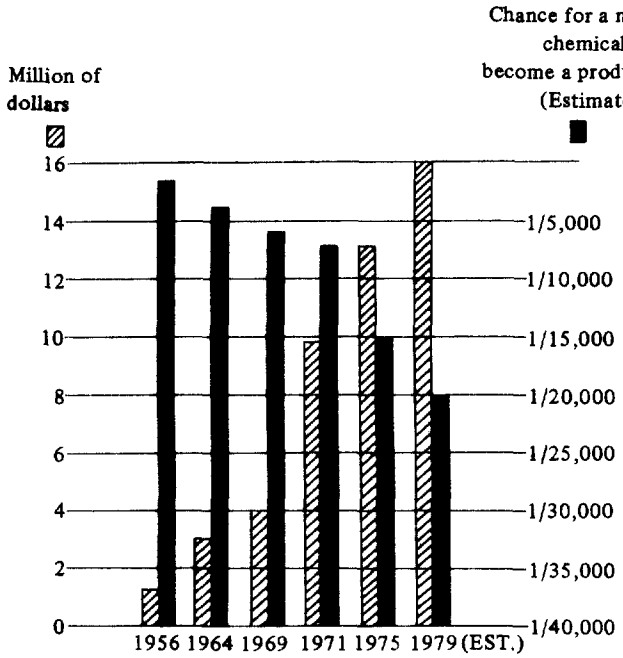


Fig. 1. Estimated Cost of Developing An Agricultural Chemical

Source: Mullison, 1975. North Central Weed Control Conference.

Weeds are not wanted. They have been under continual efforts for control since the beginning of man. I do not need to review with you the history of herbicide development, but only to remind you that synthesized, organic, and selective herbicides are relatively recent inventions in the history of crop production. However, I suggest that the past 20 years is no match for the innovations and changes in agriculture which will be brought about by agricultural chemicals in the next 20 years.

Since joining Monsanto in a technical position, I have learned all too well that discovering herbicidal activity is not the end of a long road, but rather the beginning of a long road to product development which is filled with many constraints. The decisions that follow are expensive! The stakes are great, as are the risks!

The struggle in pesticide development is not only to discover something new and beneficial to man, but also to cut through the maze of regulations, requirements, and uncertainities to bring a product that is better and safer than anything already available.

The cost of developing an agricultural chemical through registration only is increasing significantly. In the United States, costs were estimated to have increased four-fold from US $4 million in 1969 to US $16 million in 1979 for registration only. The cost of a plant or marketing launch is another 40 - 70 million dollars. There is every indication that costs will continue to rise throughout the world.

At the same time, the probability that a newly discovered pesticide can be actually commercialized has

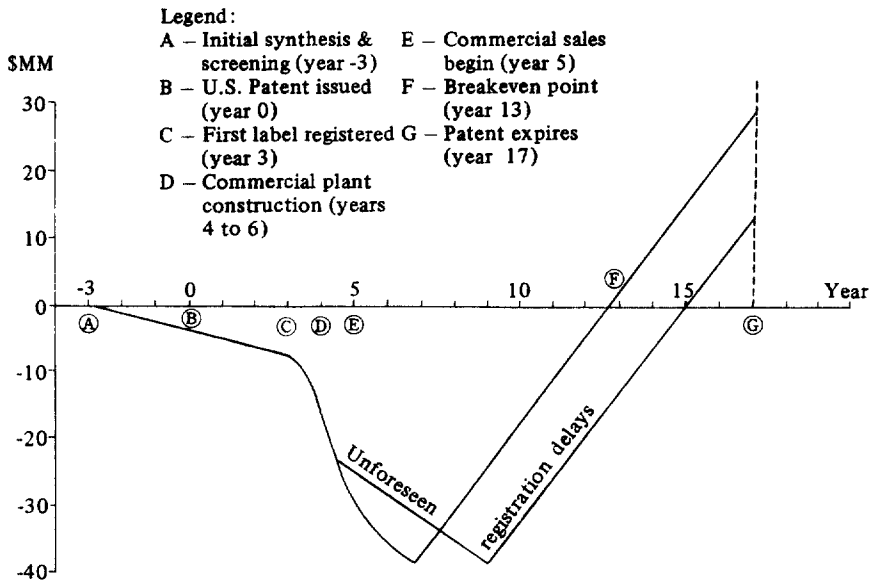


Fig. 2. Hypothetical Pesticide Cumulative Cash Flow

Source: Riggleman, J.E., 1979. The cost of regulation, Agrichemical Age. March issue.

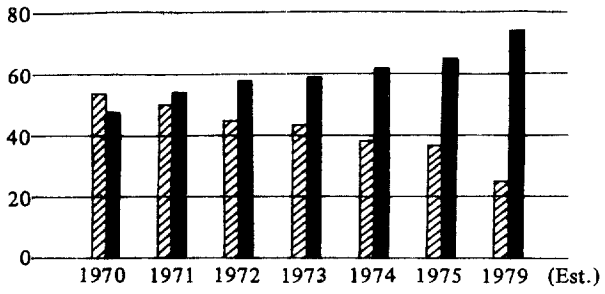
decreased considerably from 1 per 5,000 compounds in 1969 to approximately 1 per 20,000 in 1979.

A hypothetical cash flow graphic illustration for a theoretically successful pesticide shows that several years are required to recover costs. In an article in *Agrichemical Age,* J. E. Riggleman of Du Pont indicates 13 years are required. Dr. Hollis, science coordinator for National Ag. Chemical Association, indicates 14 years. Timely commercialization is required to maximize profits. Short patent protection, for example 17 years for the United States is a deterrent when government regulations necessitate 5–10 year development and registration processes. A company does not market a product for the sales achievement in the first several years, but those distant years when good and maximum development of markets are realized. In fewer and fewer cases are companies able or willing to commit the level of resources required to develop new products.

A recent report shows that in 1979 the spending for discovery was equal to the development and registration costs. However, in 1979, it was estimated that three times more was to be spent on development and registration than on discovery research. Hundreds of man-years and considerable sums of money is spent on research development and thousands of tests relating to developing efficacy, residue, toxicology, metabolism, and environmental impact data.

In addition to the rising development costs, decrease in successful compounds, and slow return and cash flow for a company, the unchecked erosion of patent protection serves as a disincentive to ensure continued innovation. Without adequate protection, industry cannot undertake the massive research involved in discovering and developing new agricultural chemical products.

A strong patent system represents an incentive for a technology transfer. Under this situation, the owner of the technology may reach a favorable decision by better understanding the business risks. Sound business decision-making must seek to eliminate as many uncertainities as possible. Owners of foreign chemical technology of potential value to various countries, including Korea, need the assurance of such a sound and progressive patent system to justify the initial expenditures and risks to make available a new product possibly through local manufacture. A negative attitude towards the originator or developer of chemical inventions is



▨ Discovery research

■ Commercialization and registration

Fig. 3. Recent trend in percentage of research dollars for discovering and developing pesticides at the Dow Chemical Company

Source: Goring, 1976. A closer look at the pesticide question for those who want the facts. The Dow Chemical Company.

not in the interest of economic development. Such attitude is a deterrent to the infusion of technology from abroad.

Perhaps, associated with this concept is another concern for confidentiality and protection of company data.

Toxicology, formulation, residue, and metabolism data should be held in strict confidence when required by and submitted to the government.

Let's examine another constraint or concern to industry-trademarks. Trademarks identify and distinguish the product of one manufacturer from similar products manufactured or sold by some one else. Trademarks should be a company's exclusive property forever. It is a symbol of certain quality, whatever it may be. All products bearing the same mark should be the same in quality. We believe that consumers can readily identify products of quality or those that fail to meet quality standards, thereby discouraging poor quality products. With the above in mind, trademarks serve the general economic interests, as well as the competitive market interests of the manufacturer or merchant. Without trademarks, there is a hesitation to introduce a product and there is no incentive to make a better product than competing manufactures. Rather, the incentive will be to produce low quality products beacause the consumer will not be able to tell the difference. Poor quality products should not become the rule rather than the exception!

Why are rising development costs, lower success rates, patents, and trademarks on my mind? Innovation by industry or placement of such technology may be stifled. While I may have sounded pessimistic, the future potential advances are great. I believe that these issues and concerns that I mentioned will be even more important as technology of agricultural chemicals advance beyond today's expectations.

A seventeenth century country boy named William Shakespeare once worte, "The Past is Prologue." Indeed, we are in the introduction phase of agricultural chemistry for the protection or modification of plants. As I suggested on the outset, that we can expect new dimensions in agricultural chemicals and crop production much more sophisticated than in the past. Due to the costs and constraints there is a tendency by leading companies to reduce exploration of "Just Another Herbicide or Chemical." The trend is to look for the new "Breakthrough" for future agriculture and a new generation of products.

The commitment to agriculture and science and the foresight of technological opportunities of commercial companies are astonishing. The competitiveness in today's pesticide environment and the needs of agriculture foster what I call "Blue Sky" research. Nothing is considered impossible only the time frame and the priority in which it is done.

Let's Briefly explore what technology may do for agriculture in the future. At the same time, what will be the impact on you as an agriculturalist, scientist, and weed specialist.

1. Genetics or new germplasm will continue to improve the potential for increased yields. However, as we pass the current genetic barriers what will be the tolerance to the large number of pesticides. Perhaps chemical antidotes and more prescription type recommendations will be required, if more

sensitive cultivars are used.

Asexual reproduction through cell biology programs can minimize the genetic variation in plants and could result in a significant breakthrough in agriculture.Perhaps plant progenies may be selected which will be resistant to certain pesticides. Wherever this technology takes us, it will have major impact on our business.

2. Antidotes for herbicides, as mentioned earlier, are alerady a reality. Specific antidotes with a specific chemicals on specific crops are now recommended. We are among a few companies to commercially "safen" a product usually injurious to a certain crop. I expect this trend to continue as research and companies strive for broader application of their herbicides and technology. Is it too far-fetched to think that herbicides of the future may be broad spectrum and non-selective in activity and the antidotes will alter the selectivity of certain desirable plants?
3. Growth regulation chemicals is not new, but it is an untapped area. Growth regulators have unlimited boundaries for more of action and subsequent effect on plants. Whether it is the fertlization process, root growth for environmental adaptability, plant tolerance to extreme conditions, increasing nitrogen or CO_2 fixation, or to alter the plant's morphology or make-up to be resistant to certain pests, the potential for success is great. We have a commercial ripener for sugarcane in world areas where natural ripening conditions are not optimum. We are exploring several approaches to plant growth regulation. The results and the promises of the future are exciting.
4. Improved herbicides by large innovative companies will tend to take two avenues. First, the broader spectrum herbicide for those uncontrolled weeds. Secondly, new products which complement current product lines for broader control, flexibility, and cropping environment. Although there is much more which can be discussed in greater detail, the impact will create many combinations of products which must be handled in a very professional manner. This leads me to my next point.
5. Integrated programs – integeration of agricultural practices, the new technological possibilities that I mentioned, and the many product choices will require even greater knowledge by you, as well as the farmer.

Weed scientists are not only entering a new era, but a new arena. The era we have discussed. However, the new arena that I refer to is the need for overlap into economic, public, and regulatory affairs, as well as the traditional education, scientific, and the integrated agricultural systems. The impact of any given agricultural practice extends to other aspects of that practice of culture method. It is essential that we, as weed scientists, work toward solving specific weed control problems within a framework of integrated pest management and crop production, and also convey the needs of the farmer and appropriate regulatory actions to the necessary people.

The new arena of economic, social, and public involvement is not clear-cut and varies with individuals. However, as I face you today, we as weed scientists and you as a society have some clear-cut challenges. We must establish effective lines of communication with our fellow scientists and with those in other plant protection disciplines. Although there are many challenges of various degrees, within the Korean Weed Science Society, I encourage you to consider some broad, but key issue:

1. Promote the development of weed science and high quality scientific studies. I am sure that all of you are already dedicated to this effort. The use of sound field plot techniques through statistical evaluation, and interpretation of data is an ever constant challenge in the education process.
2. Create or coordinate educational information, literature, and training pertinent to the advancement of our discipline. The development of weed identification manuals may be an example. The Weed Science Society of America and its regional societies have done much in refining the identification

of weeds in the earliest stage after emergence.

3. Monitor new weed problems and stimulate research extension, and regulatory programs to answer these changing weed problems.
4. Promote uniformity in weed science terminology, procedures, ratings, methodology, and observations. I have very firm convictions about the need for greater standardization among academicians, industry and experimental people. We examine and cannot use hundreds of experiments, because they lack essential information or the evaluations cannot be compared to data from other sources. This is a great loss for the decision-making process.
5. Provide for an effective organization to accomplish and implement these goals and participation in worldwide technical advances.

In summary, these represent challenges and concerns to you as individuals and as a society and industry. Weed scientists all over the world are entering a new era of inter-disciplines and a new arena of interacting roles.

Again, the agricultural chemicals of tomorrow will be much more sophisticated and will include several new dimensions such as new chemistry, plant growth regulators, or antidotes. To whom will industry turn for the key scientific acknowledgement and assistance for these dimensions? Who is better qualified than you? I do believe in a future of greater technology uncomparable to the past. However, the constraints, expenses, and risks will influence the extent and time of the achievement. As important, the protection of industrial property rights will influence the rapidity and the specific areas of the world where technologically advances will be extended or transferred.

The scientific base is in place to achieve the phenominal achievements that I mentioned earlier. I believe that achievement is on the horizon.

Recently, the Board Chairman of the National Agricultural Chemicals Association in the United States said, "Future World Food Demand Could Be Seriously Threatened Unless Reforms Are Made in Patent Protection System for Pesticides." This is only one official example of industry concern. If the world or Korea is to feed its people in the year 2000 and if we are to avert Malthus' prediction of catastrophe, we must strive to enter the new era and arena swiftly. These include improving crop production, expediting technical advances, and lend the guiding hand to regulatory people with respect to the scientific nature and needs of our agricultural chemical and weed science discipline.

Thank you.