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PESTICIDES IN MEXICO¹

by

A. Sisto Velasco
Guanos y Fertilizantes de Mexico, S.A.
Mexico, D.F.

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PESTICIDES USED.

Insecticides, herbicides, fungicides, fumigants, rodenticides, nematocides, etc., are all grouped in Mexico under the general heading of "Pesticides".

Insecticides have traditionally been the products most used. Both domestically produced and imported pesticides are available on the market; the following are the most important types:

	<u>Domestic Products</u>	<u>Imported Products</u>	
<u>Insecticides:</u>	D.D.T.	Sevin	Guthion
	Toxaphene	Lannate	Guthion
	B.H.C.	Azodrin	Asuntol
	Parathions	Malathion	Temik
	Arsenates	Endrin	Aldrin
	DDVP	Tamaron	Thiodan
	Copper sulphate	Galecron	Dipterex
		Bidrin	Perthane
		Lindane	Heptachlor
<u>Herbicides:</u>	2,4-D and its esters	Diuron	Treflan
	2,4,5-T and its esters	Paraquat	Barban
	Atrazine	Picloram	Cotaran
		Stam	Delepon

	<u>Domestic Products</u>	<u>Imported Products</u>
<u>Fungicides:</u>	Maneb	Captan
	Zineb	Hexachlorophene
	Copper compounds	Dyrene
	Pentachloronitrobenzene	Diphenyl
	Organomercurials	
	Vapam	
<u>Fumigants and</u>		
<u>Nematocides:</u>	Carbon disulfide-	Paracide
	tetrachloride mixtures	Nemagon
	D-D	1,2 Dichlorethane
		Dibromide of ethylene

Sales of pesticides were estimated in 1967 at 700 million pesos, distributed as follows: Insecticides, 75.2%; Insecticides for home use 9.0%; Herbicides, 8.1%; Fungicides, 5.2%; Others, 2.5%.

About 20 pesticides are manufactured in the country, and the number of imported products is on the increase, reaching 126 in 1971. Imported pesticides are enumerated by groups in the following table:

<u>Year</u>	<u>Insecticides</u>	<u>Herbicides</u>	<u>Fungicides</u>	<u>Fumigants</u>	<u>Others</u>
1962	22	--	2	9	6
1963	23	1	2	9	6
1964	22	3	3	8	7
1965	42	14	10	10	7
1966	56	24	16	13	9
1967	59	28	18	14	10
1968	57	34	20	12	14
1969	67	37	20	11	13
1970	64	31	12	11	13
1971	63	25	17	12	9

In tonnage, the insecticides most employed are the parathions, DDT, toxaphene, malathion and Sevin. The two last-named products are imported.

The following table shows the results of a study of imports from 1962 to 1971:

Year	Amount (Metric tons)	Value (Million of pesos)	Number of Products
1962	12,611	187.5	79
1963	12,578	177.7	81
1964	14,278	183.4	83
1965	21,019	267.5	89
1966	18,915	241.5	118
1967	17,817	206.5	129
1968	23,828	283.3	137
1969	21,864	301.3	148
1970	18,457	234.9	131
1971	13,148	241.7	126

Total imports from the preceding table include the parathions, which were under strict control by the Government by the fact that Mexico began producing parathions during the latter half of 1962. An analysis of the percentages of the amount and value of total year imports represented by the various groups of products follows:

Year	Insecticides		Herbicides		Fungicides		Fumigants		Others	
	Am't.	Value	Am't.	Value	Am't.	Value	Am't.	Value	Am't.	Value
1962	12.43	96.93	*	-	9.02	0.01	6.85	2.66	0.17	0.40
1963	39.47	95.38	0.01	0.02	0.07	0.09	9.56	3.14	0.73	1.37
1964	21.72	95.48	0.70	0.90	0.22	0.19	6.86	2.98	0.70	0.95
1965	77.10	91.30	1.26	1.73	0.65	0.60	20.64	5.72	0.35	0.65
1966	72.26	88.17	1.43	2.84	1.93	1.49	23.50	6.70	0.78	0.80
1967	67.39	79.61	2.54	7.96	1.54	1.62	33.15	10.15	0.59	0.66
1968	67.09	82.10	4.67	9.85	1.78	1.79	25.90	5.49	1.61	0.78
1969	75.50	85.39	4.14	6.41	1.42	1.44	16.42	5.03	1.52	1.73
1970	57.15	76.13	4.77	10.42	4.50	3.80	31.58	7.78	2.00	1.87
1971	74.54	84.90	3.87	8.20	2.77	2.13	17.93	3.83	0.89	0.94

USE ACCORDING TO MOST IMPORTANT CROPS AND PESTS

Pesticides are generally employed in Mexico mainly in such crops, particularly cotton, which accounts about 60% of all insecticide applications. The pesticide market therefore, leans to a large extent to the cotton crop situation.

The total land area devoted to cotton cultivation in Mexico has been diminishing in recent years and in spite of government efforts to increase it, appears to tend to remain steady at about 450,000 hectares.

The most important pests combatted are: bollworm, *Heliothis* sp.; pink bollworm, *Pectinophora gossypiella*; boll weevils, *Anthonomus grandis*; thrips; Leaf armyworm, *Spodoptera exigua*; cabbage looper, *Tricoplusia ni*; cotton leafworm, *Alabama Argillacea*; cotton leaf perforator, *Bucculatrix thurberiella*; cutworms; salt-marsh caterpillar, *Estigmene acrea*; yellow-striped armyworm, *Prodenia ornithogalli*; cotton aphids, *Aphis gossypii*; whiteflies, *Trialeurodes abutilonea*; cotton fleahopper, *Psallus seriatus*; Lygus bugs, stinkbugs, and spider mites.

Pesticides are also used on other crops such as tobacco, garden produce, rice, wheat, sorghum, sugarcane, fruits, and, to a lesser extent, on corn.

Public health programs employ DDT aspersions in combating malaria vectors (mainly *Anopheles albimanus* and *A. pseudopunctipennis* mosquitoes). The 75% wettable DDT meeting WHO specifications is manufactured in the country. A certain amount of malathion has also been used for this purpose.

Animal sanitation programs include a national tick-eradication campaign that is principally directed against the *Boophilus* and *Amblyomma* genera and uses Asuntol and Copumex to combat these pests.

Although some nematode problem exist, mainly with *Meloidogyne* sp, *Ditylenchus* sp, and *Pratylenchus* sp, it cannot be said that the control of these pests is being given the importance it deserves. The same can be said of forest and timber pests, which are practically uncontrolled. The most important of these are the Zadi-

prior *Vallicola* and the *Dendroctonus frontalis*.

Increased importance has recently been given to the control of the pest known in Mexico as the "salivazo" or "mosca pinta", names given to the *Prospia simulans* and the *P. bicineta*, varieties of the *Aneolamia postica* (*postica*, *A. postica campechana*, *A. postica occidentalis*, *A. postica santarosae*) which affect grasses and sugarcane and are the object of a national eradication campaign. Control is effected by means of cultivation techniques and application of granulated insecticides (Sevin and BHC). Other pests attacking sugarcane include borers, cutworms, and weevils.

INDUSTRY STRUCTURE.

Agriculture is still the main activity in Mexico; 49.4% of the country's population is employed in tilling a total cultivated area of approximately 15 million hectares. A considerable percentage of agricultural production of cotton, sugar, coffee, tomatoes, etc. is destined for export, thus providing the foreign currency that is an important element to our development.

Production of more and better foodstuffs to improve the diet of the country's inhabitants, to meet the growing demand resulting from population growth, and to provide the exports just mentioned requires, among other things, a greater use of pesticides.

Such use, however, depends in turn on a series of factors that include an intensive effort to teach the nation's farmers to recognize the various pests and blights and to use the most appropriate elements to combat them. Both public and private sectors are involved in this effort, which includes promoting the diffusion of information regarding the most effective techniques to be followed in each case. Other decisive factors are those of an economic nature, to be discussed at a later point.

The pesticides industry in Mexico may be divided into two types, as follows:

- A) Companies devoted to the manufacture of technical products.
- B) Companies which utilize these products in the formulation of mixed insecticides - used by farmers.

Although Mexico has been producing arseniates and copper sulphate (the latter of particular interest in banana cultivation) for many years, the pesticides industry in Mexico may actually be considered to have begun with the Type B/installations, mixing or formulating plants that employed imported raw materials in an effort to provide substitutes for imports of finished products. In 1953, there were 22 plants of this type, a number which had increased to 45 by 1962, and to 70, scattered throughout the Republic, by 1970.

The modest initial investment in such plants was augmented in 1953 by some 37.5 million pesos (3 million dollars) for the purpose of substituting different types of imports for those previously entering the country, and by 1970 it had grown to 270 million pesos (21.5 million dollars).

The latter investment represents 2.95% of the total investment at that date in the chemical industry as a whole, of which 1.44% corresponds to the production of technical substances and 1.51% to the formulation industry, not including chlorine production, which is closely linked to that of insecticides such as DDT, BHC and chlorinated terpenes and camphenes.

The consumption growth rate is estimated at 7% per year.

As the statistics show, herbicides, fungicides, fumigants and others, account for a mere 25% of the total value of all pesticides employed in agriculture.

Several foreign companies produce a number of these products, but in the majority of the cases their manufacture in Mexico is not integrated and is confined to the final step of the synthesis based on imported semi-finished materials.

Manufacture of basic insecticides began, as stated above, with arseniates and the copper sulphate used in banana cultivation. At the beginning of the 1950-1960 decade, a BHC plant was constructed near Mexico City with a view to covering the needs of the cotton growers, but it never entered production. In 1957, Montrose Mexicana, S.A., a joint private enterprise in which Mexican capital was associated with Montrose Chemical Corporation of California, began producing DDT in Mexico in a plant having an annual capacity of 10 million pounds of technical products.

The construction of a plant of this capacity was justified by the size of the domestic market, the attractive economic conditions that accorded with international development of the industry during that period, and by the fact that sufficient national production of benzene, alcohol, and oleum was on hand, although it later proved necessary to augment oleum production capacity. Since domestic production of chlorine was at that time insufficient - the Pennsalt and Cydsa plants were built during more or less the same period - the installation of a chlorine plant that would also cover the needs of the rayon-grade soda market that already existed in the country was considered justifiable.

Shortly after this plant began operations, Pennsalt and Diamond, transferring the competition problems existing in the United States to Mexico, decided to join forces in a second DDT manufacturing venture in our country, in which the first company provided the m-chlorobenzene and the second handled the succeeding phases of DDT manufacture, using imported acetaldehyde, for which reason it may be considered that the industry never achieved total integration. Their plant had a capacity of 4 million pounds, and with its appearance total installed capacity reached a point that was some 30% in excess of the country's needs at the time.

In 1961 to 1962 first Bayer and then Monsanto began placing imported parathion on the market, and in 1963 Union Carbide began importing Sevin. All

these products ate into domestic market for technical DDT, which by 1967 had been reduced to only half of what it had been during the period from 1958 to 1960.

In 1962, the same motives that had justified the installation of the DDT plant (existence of an adequate domestic market and of nationally produced raw materials such as turpentine) led Montrose Mexicana to begin manufacturing toxaphene. Immediately, another foreign company began competing with a similar product (Strobane), although it abandoned production in 1968.

Interest in BHC also revived during this period. In 1964, both Montrose Mexicana and Diamond began manufacturing this product, and since 1967 production has been sufficient to meet the domestic demand.

A project calling for the construction of an integrated parathion plant was presented in 1965, but opposition by the firms that possessed the technology, and internal problems, delayed its execution and it did not really begin to take shape until 1968. The project finally resulted in a plant with an annual capacity of 16 million pounds (7,500 MT/year) whose construction was begun by Montrose Mexicana and completed by Guanos y Fertilizantes de México.

The plant was designed to provide sufficient production to cover the domestic demand, and although the lack of certain raw materials (phosphorus and p-nitrophenol) has prevented complete integration with Mexican raw materials, the necessary steps to increase integration are being taken and by the end of this year it is expected to reach 70% on that basis. However, the plant is fully integrated from a process view point.

A matter of considerable interest is an examination of the manner in which the technology for the development noted above was acquired.

Considering that the research and development period for a new product is from 7 to 10 years, with all the expense that this implies, and that it may easily be

10 years before the product can enter the market, it is only logical that any company that has taken out patents to protect its product will try to achieve maximum profits from it during the life of the patents. Where new developments in technology - that are not patentable are concerned it is even more likely that the companies involved will envelop their processes in a veil of secrecy and refuse to divulge them in any way.

This situation makes it difficult to acquire technology and the problem can only be solved in one of two ways - either by association with foreign manufacturers or by direct purchase of the technology, although the latter possibility is far more problematical in this particular field.

It was only through association with the companies possessing the technology or patents, which licensed their use in return for part of the capital of the Mexican companies, that Mexican concerns were enabled to begin producing DDT and toxaphene, and in the latter case negotiations with the holders of the patent were started only about 3 years before the patent was to lapse.

Direct purchase accounted for the acquisition of the technology involved in the manufacture of BHC, where adaptations were required; the technology needed - for the production of 75% wettable DDT which was ceded by the former foreign partners of the Mexican company, and the technology required for the manufacture of parathions, after long and difficult negotiations with the three most important manufacturers of the product.

All the contracts contain a continuous disclosure clause in favor of both parties with a 10-year duration, except in the case of the parathions where the clause has a duration of 5 years. None of the contracts calls for the payment of royalties - based on local sales of the products involved.

Cause for satisfaction was found in the fact that the processes acquired incor-

porated the latest improvements and all the refinements achieved by the companies ceding the technologies, which made it possible for the new plants to perform more efficiently than the original installations and would consequently lead to product prices that would be competitive on the world markets if raw materials could be purchased at the same prices obtaining in countries with a well-developed chemical industry. This, however, is not always the case with our raw materials, whether imported or domestic.

All the products have proved technically unobjectionable and have complied with the strictest United States or United Nations specifications, as the case may be. Exports of DDT have been made to 14 countries, and toxaphene has been exported to Central America and Colombia.

In view of the fact that the pesticides market in Mexico (and in Central America) had traditionally been covered by producer nation exports of surplus production at dumping prices which provided an easy way of getting rid of such surpluses, the appearance in Mexico of an industry that affected that situation by its manufacture of basic products was met with strong foreign opposition that made every effort to hinder its development.

This situation, together with problems that arose among the various companies that exported these products to Mexico, affected not only the pesticides market but also agriculture itself. Since agriculture, as we have previously noted, is a basic element in the national economy, the government, which had already completed a program to concentrate fertilizer production under the management of the state enterprise "Guanos y Fertilizantes de México" S.A., decided that the time had come for it to take a hand in technical insecticide production. This decision led in 1969 to the purchase of Montrose Mexicana, S.A. and Lerma Industrial, S.A., both owned by the same Mexican shareholders and a minority foreign partner, which

became part of the above-mentioned state enterprise and gave it almost complete control of the manufacture of basic technical materials in the country.

Manufacture of formulated pesticides, however, has been left entirely in the hands of private companies that operate local formulation plants and are considered useful in view of the credit they extend to their clients and their knowledge of local markets, valuable in a country that has such diverse problems of biological control as Mexico does.

THE INDUSTRY'S FUTURE AND THE PROBLEMS IT PRESENTS.

Mention has already been made of the difficulties involved in persuading - companies that possess advanced technology to grant concessions for its use either before they have at least recuperated their expenditures on research and development or before the process is due to enter the public domain, or when they have developed a new product that offers considerable advantages over a preceding one.

Under present conditions we face a situation in which new products that replace those formerly used, compete with them, or complement their use, are more - and more frequently being introduced in the market on a worldwide scale. This situation is due to the following basic causes:

a) Resistance developed by pests to a specific product, although it might be noted that there have been few problems of this type in Mexico.

b) Real or supposed harmful effects on human beings caused by the failure of certain plagicides used in crop or livestock production to descompose, or by their direct or residual contribution to environmental pollution.

c) New products whose appearance is due simply to technological advances or to competition among various companies for domination of a growing market.

In Mexico, as in any developing country, the continual introduction of new products by international companies that is not necessarily due to valid scientific or technical reasons obliges the incipient national industry to compete under unfavorable conditions that in some cases lead to its virtual displacement from the market. We have neither the means nor the large sums of money required for developing the manufacturing processes and technology that would enable us to compete with a highly advanced chemical industry in the constant development of new pesticides.

Furthermore, even though potential consumption may be enormous, current demand does not always permit installation of a plant under favorable competitive con-

ditions, although in Mexico's case the construction of the previously mentioned - plants for the production of insecticides with a broad spectrum and of the herbicides most in demand proved justifiable.

Our production, at first limited to chlorinated products, was recently extended to include organo-phosphates. Since the former tend to be replaced by other products and the latter face strong competition from organo-phosphates and carbamates for specific uses, there is a growing uncertainty regarding the future of the industry and investment in new facilities that limits the part domestic industry can play in supplying consumer demand.

Because of the manner in which the pesticides industry in Mexico has evolved, almost every kind of pesticide produced in the world is available on the market and over a hundred of them are in use.

Two basic, and markedly different, approaches to the problem of home market pesticides needs may be noted:

a) On the one hand, opinion in government circles tends to favor the establishment of a basic table of products for use in pest control. This would permit the creation of a pesticides industry with a fairly well-defined market.

b) On the other hand, private initiative favors unrestricted use of all pesticides and cites insect resistance and environmental pollution problems in support of its position. This approach prevents any real development of a domestic pesticides industry, since the cost to the country of constructing expensive facilities that might operate for only a few years would be prohibitive. Furthermore, such installations could only be constructed for the manufacture of those products that the owners of the proprietary patents and specialized processes consider it convenient to provide.

In short, the dilemma that must be faced lies in choosing between creating a national industry, with all its inherent problems such as the difficulty of acquiring adequate technology, the small size of the market, expensive raw materials, etc.,

or importing the pesticides that are in style at the moment and resigning ourselves to the constant drain this implies on our foreign currency reserves. And in making our choice we must always bear in mind the interests of the farmers, who would be those most affected by a mistaken decision.

CONCLUSIONS.

- I.- The pesticides industry in Mexico has reached a point in its development in which prevailing national and international circumstances make any significant extension of the industry under favorable competitive conditions very difficult, considering the small volume of the demand for the products not being manufactured in the country at the present time, with the possible exception of some organo-phosphates.
- II.- In our opinion, the most viable procedure for resolving the numerous difficulties faced by developing countries in their efforts to obtain the necessary technology is the formation of mixed capital enterprises in association with companies that have the technology. The nature of the industry makes it extremely unlikely that developing countries will be able to develop technologies of their own.
- III.- The small size of the market for each specific product and the wide variety of products offered on the market limits manufacturing possibilities and hinders the development of the industry.
- IV.- UNIDO could collaborate most effectively with the efforts of the developing countries to create efficient pesticides industries by providing assistance in acquiring technologies, orientation as to the most feasible paths to be followed and products to be manufactured, and recommendation and promotion of the creation of appropriate regional plants (for example, plants serving multinational regional markets such as LAFTA) or of similar steps that might be taken to overcome the obstacles represented by the small size of the various domestic markets.

Adolfo Sisto Velasco
Development Manager, Guanos y Fertilizantes de México, S.A.
1973.

ANNEX I

LEGISLATION, STANDARDS, AND RULINGS REGARDING ENVIRONMENTAL POLLUTION.

In Mexico, the basic regulations concerning pesticides and their use are mainly those issued by the Ministry of Health and Welfare and the Ministry of Agriculture and Livestock Production.

The Ministry of Health and Welfare Sanitary Code and its corresponding Regulations and Instructions control insecticides produced for domestic use, while the Law for the Prevention and Control of Environmental Pollution gives this department's Underministry for Improvement of the Environment control over all other pesticides.

The Bureaus of Vegetal and Animal Sanitation of the Ministry of Agriculture and Livestock Production are respectively responsible for all regulations and instructions concerning agricultural pesticides and insecticides used in livestock production.

Other regulations issued by the Ministries of Industry and Commerce, Labor and Social Assistance, Water Resources, and Communications and Transport also effect some or all pesticides in one way or another.

General control over all such standards is exercised in Mexico by the Bureau of Standards of the Ministry of Industry and Commerce. In collaboration with representatives of the public and private sectors (manufacturers, formulation specialists, and importers) and of universities and other research centers, it sets sampling, quality, and testing standards for pesticides. These standards become official upon their publication in the Official Journal of the Federation, and are considered obligatory for technical products, but no official standards have been set for the formulations used by the farmer.

Because of the rapid and relatively recent developments in the field of pesticides,

the antiquated laws, regulations, and rulings concerning them, the lack of any coordinating or ruling body, and the insufficient number and nature of control and testing laboratories, the legal requisites covering manufacture, formulation, importation, packaging, labelling, storage, transportation, marketing, handling, and application of pesticides are complicated and frequently confused, and therefore difficult to fulfill and to control. Annex II provides a résumé of the requisites to be fulfilled by those engaging in the various activities having to do with pesticides.

Action is now being taken to allay the concern provoked by the situation just described and to simplify and unify the many rulings and the paperwork they involve through the preparation of a new set of official Pesticides Regulations that will deal with every aspect of the manufacture and handling of these substances with a view to diminishing the risks arising from their toxicity.

The new Pesticides Regulations are being drawn up by a working committee named by the Technical Council of the Underministry for Improvement of the Environment. The committee is composed of representatives of government agencies whose work is related to different aspects of the pesticides industry and representatives of private and government-participation industry. Its members are expected to act independently, rather than as spokesmen for the agencies or industries they represent.

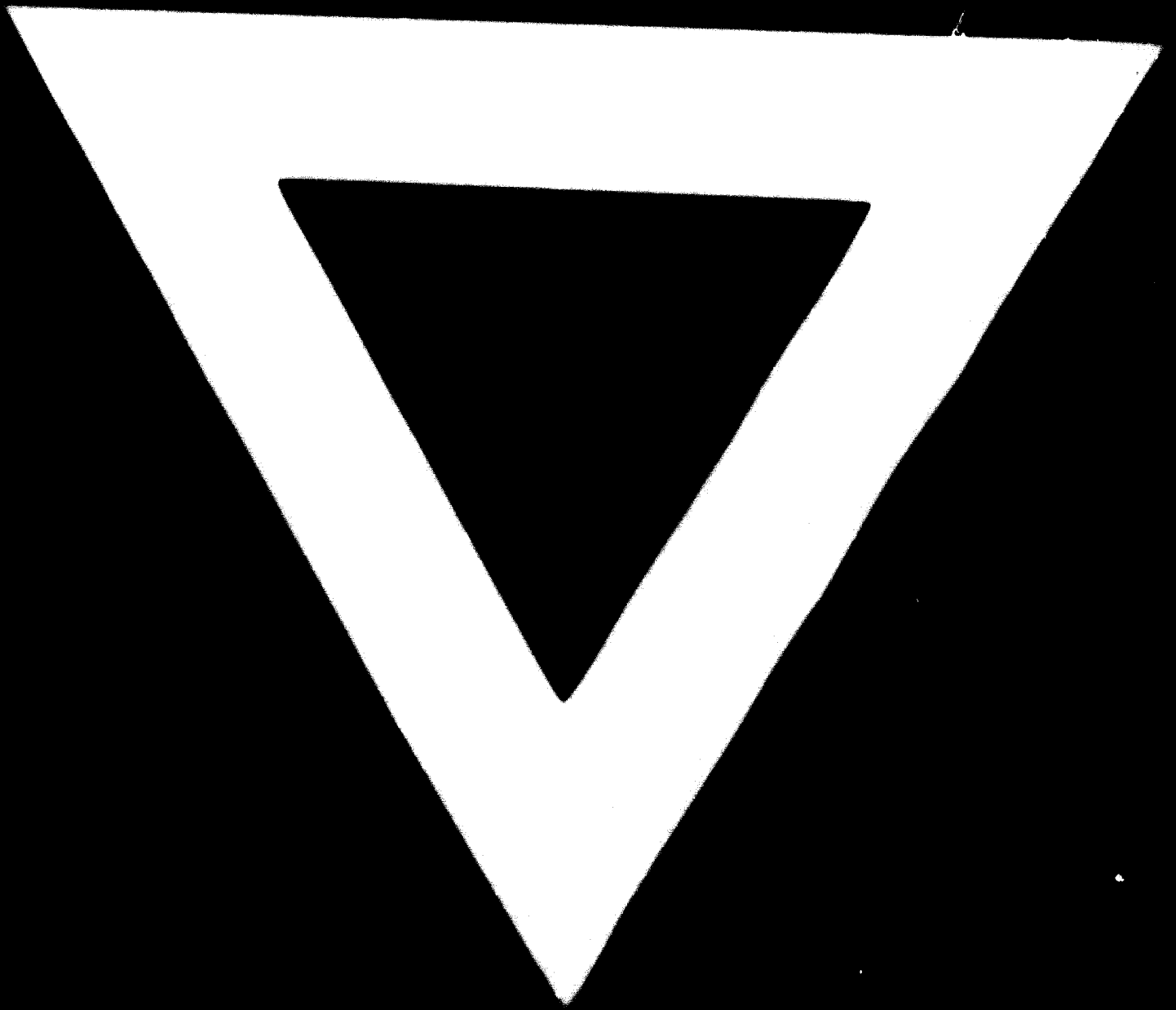
The new regulations will probably include the creation of a National Committee for Pesticides Control, coordinated by the Underministry for Improvement of the Environment and including representatives of all the government bodies that intervene in any way in pesticides legislation or might reasonably be expected to do so in the future. The Committee will grant licenses for the manufacture, formulation, importation and sale of pesticides. Each specific pesticide will later require a special permit to be issued by the agency most responsible for its control - that is, by the Bureau of Vegetal Sanitation if an agricultural pesticide is concerned, by the Bureau of Animal Sani-

tation if the pesticide is for use in livestock production, and so on.

The Pesticides Regulations will also include general rulings covering the manufacture, formulation, importation, packaging, labelling, storage, transport, marketing, handling, application, and residues of pesticides. The specific requisites established by the Regulations will conform to the official standards currently in effect, and the standards that are considered to be in the general public interest because of their effect on pollution will be made obligatory.

In dealing with pesticides residues, the National Committee for Pesticides Control will draw up a national list of tolerances to be based on data concerning the toxicity of each product and the diet of the Mexican population. To facilitate the observance both of these national tolerances and of international tolerances in cases of exportation, plans are being made for a central pesticides residues laboratory that will keep official sampling and analysis standards up to date, serve as a training center for laboratory technicians for other centers, provide arbitration in cases where this is required, and supply the legal basis for action by the Underministry for Improvement of the Environment when measures must be taken against high residues from pesticides.

The National Committee for Pesticides Control will also implement programs for providing information on techniques for reducing the risks arising from pesticide use, since efforts of this type are considered to be those that will provide both the most positive results and the best justification for the new Pesticides Regulations.



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