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The Agrochemical Business Prospects in Japan

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Introduction

Let me introduce myself briefly. I graduated from Kyoto University in 1947, its engineering department, with a major in organic chemistry. For the subsequent five years, I studied organic synthetic chemistry in the graduate school. After obtaining my doctor's degree there, I became a lecturer of Kyoto University and also an assistant professor of applied chemistry division, science and engineering department of Kinki University in Osaka. At both of the universities, I taught organic synthetic chemistry.

In 1956 when Rohm and Haas Company of the U.S. and Nissan Chemical Industries, Ltd. of Japan jointly established Tokyo Organic Chemical Industries Ltd., I entered this company at the very start of its operation. As chief chemist, I was in charge of research, development, technology and sales in general. Since then, for 32 years, I have been working in research and development as well as marketing of agricultural chemicals and ion exchange resins in Japan. Later, one of the shareholders of our company was changed from Nissan Chemical to Toa-gosei Chemical Industry Co., Ltd.

Agriculture in Japan in around 1956 was quite different from the present agriculture. Enormous changes have took place since then. Not only in Japan, but in other countries I think many similar changes have took place in agriculture, though the aspects of the changes were different by country. It is very difficult to forecast the agriculture in future based on these changes experienced for the past 32 years. However, I believe such experiences would be suggestive to you. As Japanese agriculture has changed, the agricultural chemicals and, consequently, agricultural chemicals industries in Japan have greatly changed.

Incidentally, what R & H Co. of the U.S.— our partner of the 32-year joint study and the 50%-shareholder of our company-introduced to Japan was not an agricultural chemical for rice cultivation but a horticultural fungicide, Dithane. Pesticides being used at that time in Japan were mainly for rice growing, but during the following 30 years they have expanded to the field of horticulture. This product, Dithane, is now playing the very important role for horticulture.

I. Agriculture in Japan

Before talking about the agricultural chemical industries in Japan, the subject of my speech, I would like to show you the characteristics of Japanese agriculture using some statistical data.

Japan stepped into the path toward a modern state one hundred and twenty years ago ; since then, waves of the westernization have influenced upon every aspect of our daily life. In particular, our eating habits were remarkably influenced. With this change in eating habits for a background, Japaneses agriculture has changed so far. Through imporvement of plants and introduction of machinery, fertilizers and agricultural chemicals, Japanese agriculture has prog-

* 1988. 12. 10. 학술발표회 특별강연, (전남대학교) *Tokyo Organic Chemical Industries, LTD.*

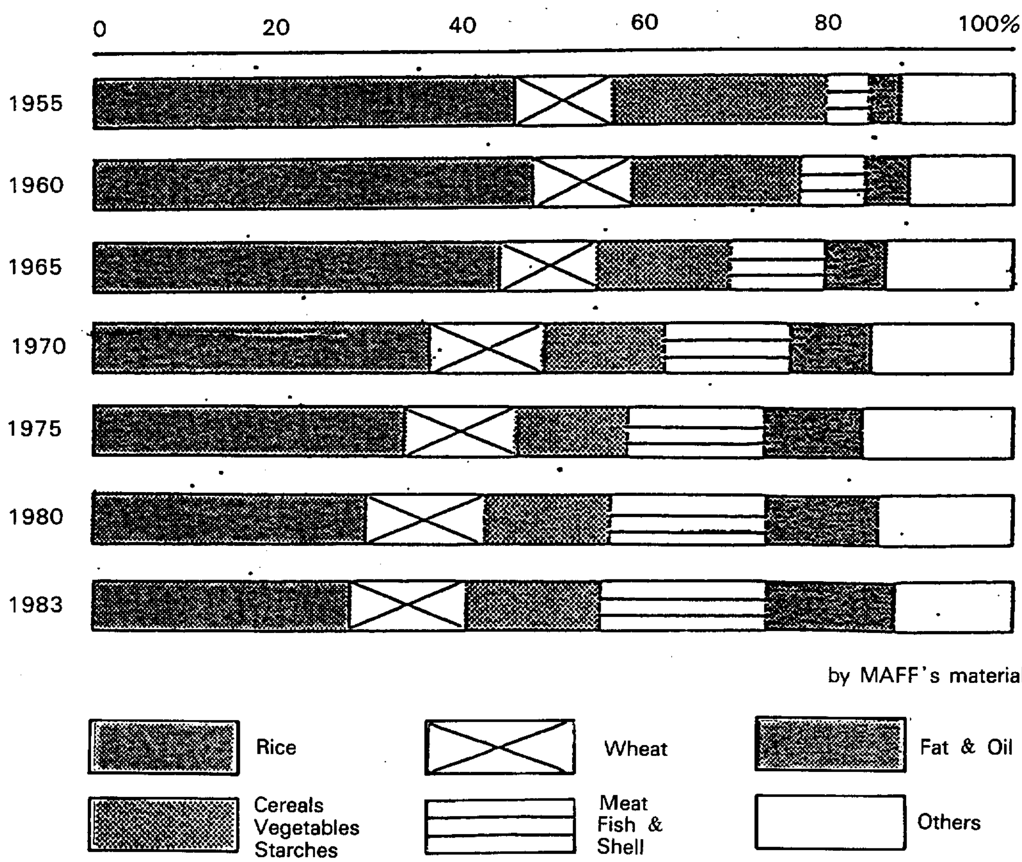
ressed so far and is still changing.

(1) Changes in food life and accordingly the type of agriculture
— Rice-oriented eating habits

It seems that the eating habits of the Japanese have been rapidly westernized since the start of the modernization. However, when we, the Japanese, see our eating habits from the view point of "rice", which has been the main food of the Japanese from ancient times, our eating habits have not changed so much. According to the statistics on the sources of calorie of

Transition of Calorie Source

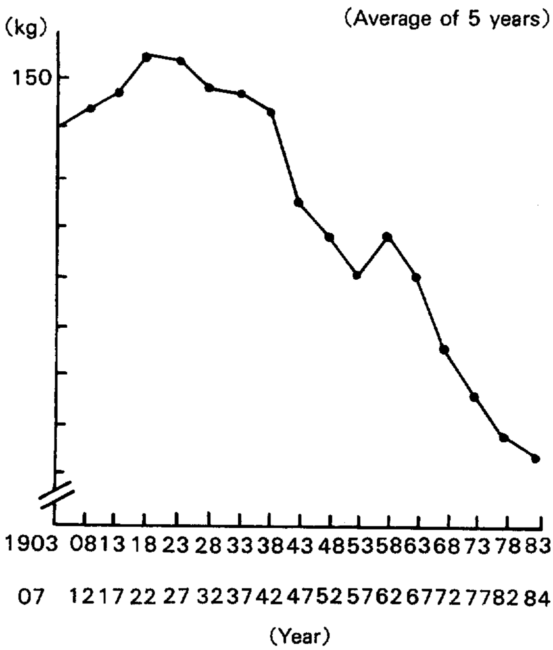
(Component ratio per person)



by MAFF's material

the Japanese, rice ranks first by far exceeding wheat, minor cereals, starches and fats & oils. As diversification of diet has progressed after the Second World War, consumption of rice per person has been decreasing year by year since 1962, but "rice" is still keeping its leading part in Japanese diet.

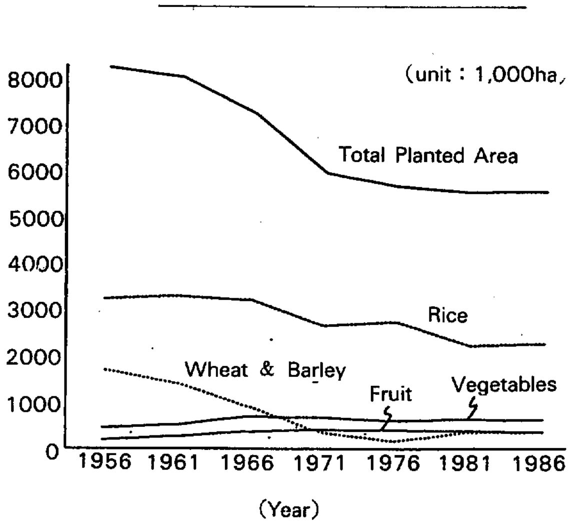
Annual Consumption of Rice per Person



— Transition of planted area by agricultural product

Let us see the planted area for the past 30 years by agricultural product. The areas of rice, wheat, cereals, beans and potatoes indicate remarkable falls. The area of rice has been reduced by 30% since 1960. The production of rice in Japan increased as the result of imporvement in rice prdocution technology and the requirement of the Japanese people for rice has decreased since the latter half of 1960's. The Japanese Government has therefore taken the policy to adjust this gap between the supply and demand of rice. Eventually, the production adjustment of rice has taken place several times since 1971.

Aggregated Planted Area of Crops

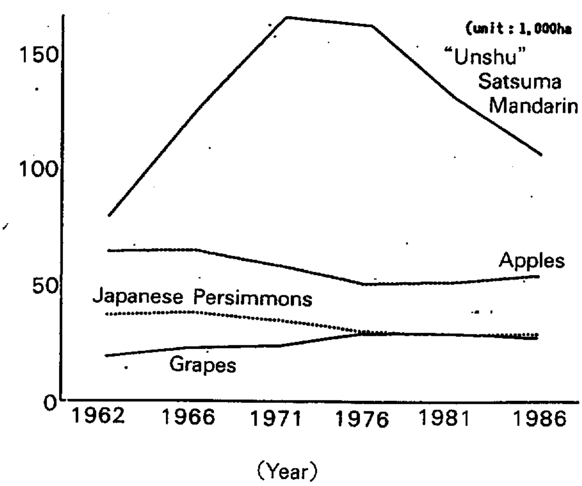


However, while the total agricultural planted area has decreased by more than 32% for the past 30 years, the ratio of rice area against the total area is almost maintained at 40%.

— Conversion of rice to vegetables, fruits and others

The areas of vegetables and fruits show their peaks from the latter half of the 1960's to 1970, and after that they almost remain on the same level.

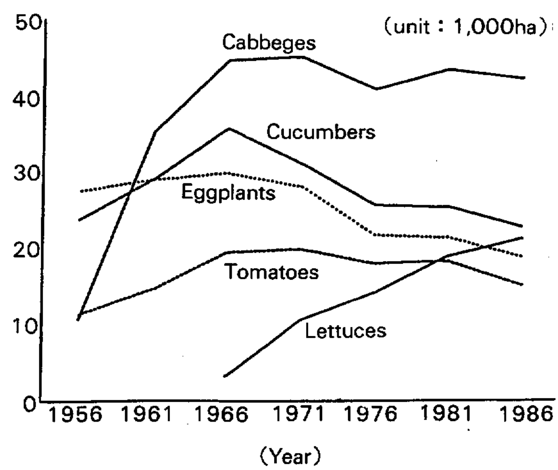
Growing Area of Fruit (unit : 1,000ha)



As far as fruit is concerned, there are problems of excessive production and liberalization of the orange import. Under such circumstances their area has been decreasing lately ; in particular the area of mandarine orange (Citrus Unshiu) which occupied almost 50% of the total fruit area has decreased. The total area of fruit has fallen to the 90% of its peak level marked at the beginning of 1970.

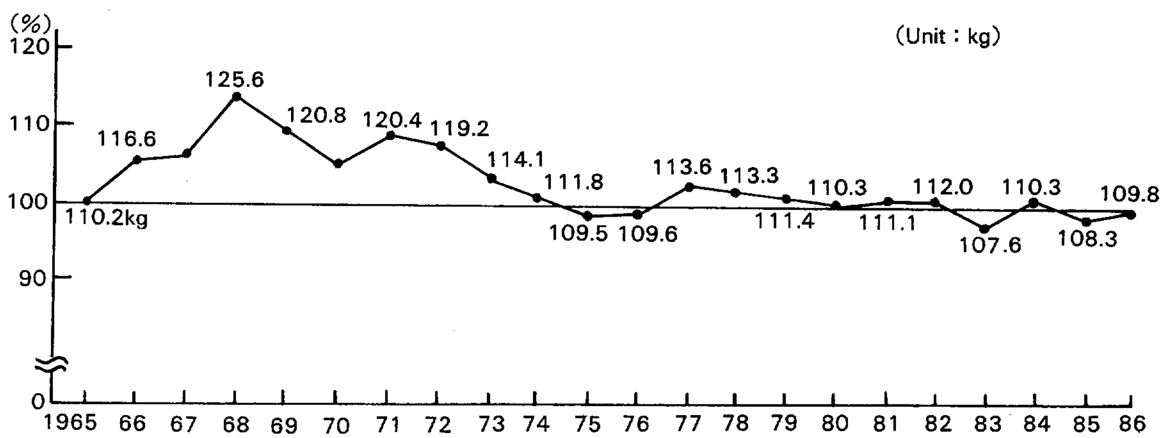
As far as vegetables are concerned, the area as a whole remains on the same level in these years, but western vegetables and Chinese vegetable indicate remarkable growth. For your information, the consumption of vegetables per person has shown almost no change for the past 10 years.

Aggregated Planted Area of Vegetables



Annual Consumption of Vegetables per Person

(37 items, Edible Parts)



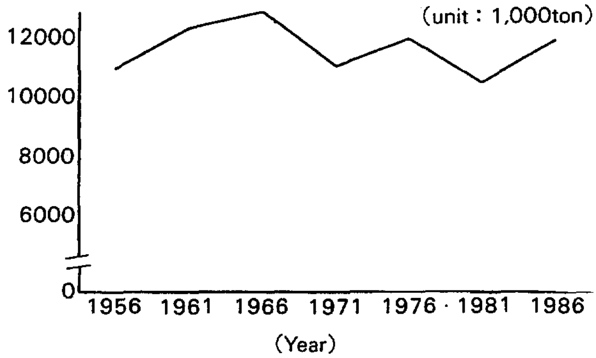
(Index : 1965=100)

(2) Changes in agriculture seen from production volume

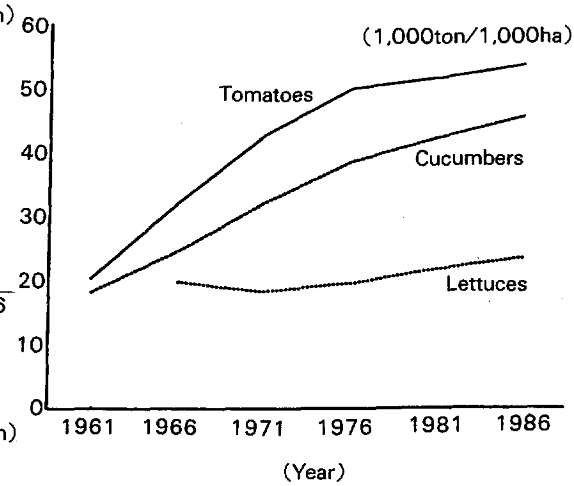
When we look at the agricultural production for the past 30 years, there is not so much change as we have seen in the change of planted area. The yield of rice at its peak in 1966 was 12 million and 7 hundred thousand(12,700,000) ton and it became 11 million and 6 hundred 50 thousand (11,650,000) ton in 1986. Namely, the reduction rate of the yield was 8.3% and the reduction rate of the growing area for the same period was 29%.

The way to increase the yield per acreage, namely, to pursue the production efficiency is employed not only in rice cultivation but also in vegetable cultivation. This idea may be a traditional one for the Japanese farmers who have very limited land for agri-

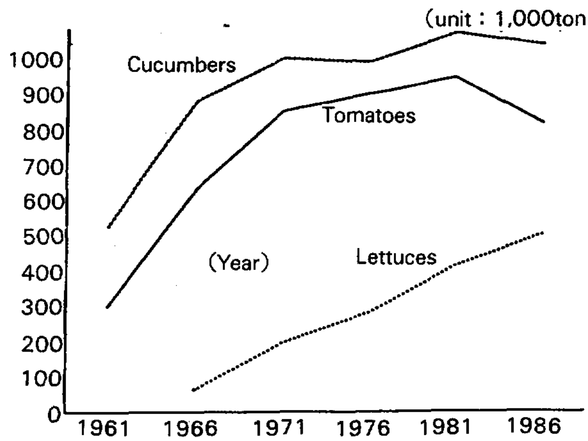
Annual Production of Rice



Average Yield of Vegetables



Annual Production of Vegetables



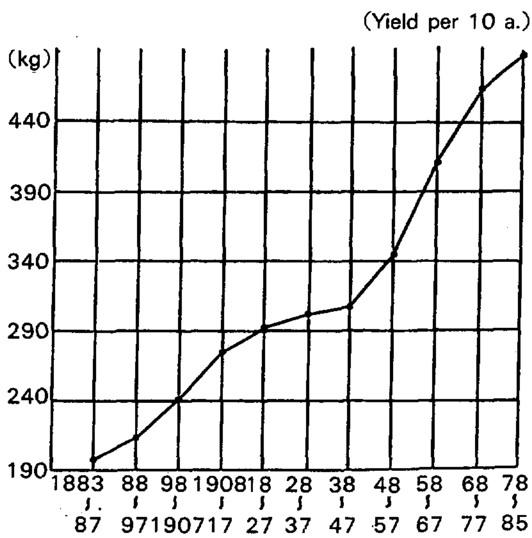
culture.

Major factors of this production imporvement to Japanese agriculture are, I think, indtroduction of machinery and advancement of the cultivation technology, including the usage of fertilizers and agricultural chemicals for pest control and weed control and so forth, in the recent years. Of course the development of new plants and new varieties also contributed much to the progress of the agriculture.

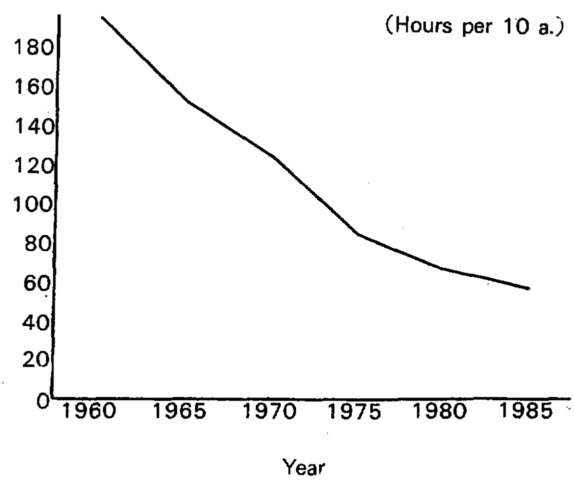
(3) Production cost

As to production cost, Japanese agriculture is ra-

Average Yield of Rice (Paddy Field)

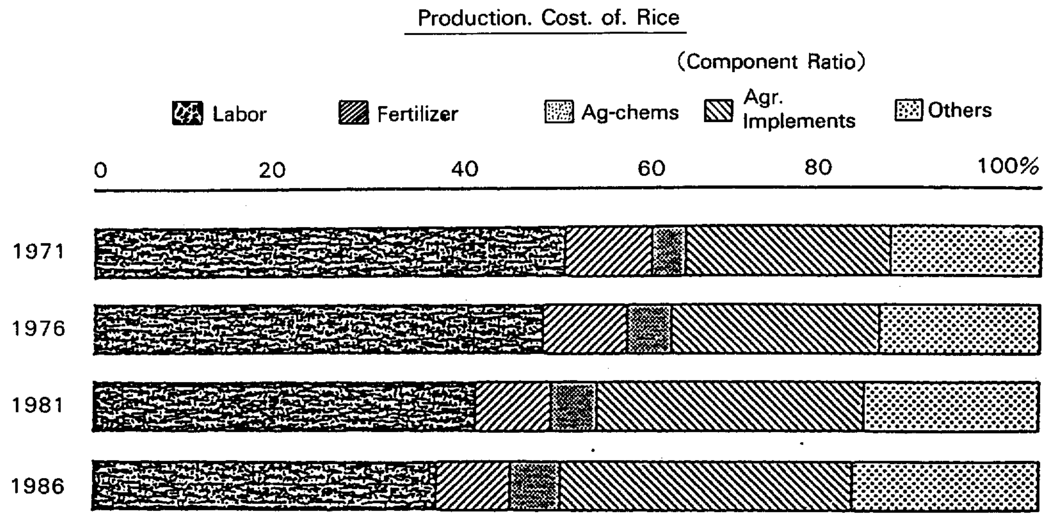


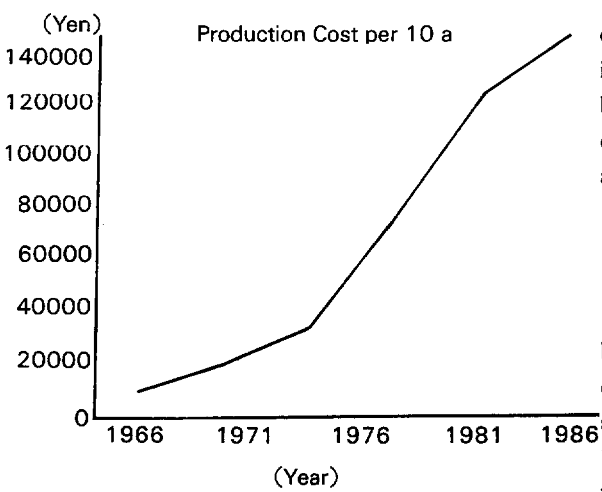
Transition of Working Hours for Rice Cultivation



ther weak, though it has been competing through collecting technologies and pursuing high product quality as well as high production efficiency in the same way as the other industries in Japan have done.

As far as the rice cultivation is concerned, the working hours has decreased by more than 70% for the 25 years from 1960 to 1986, namely from 194.8 hrs. per 10 a. down to 54.5 hrs. This is due to mechanization and introduction of agricultural chemicals. Nevertheless, the labor cost occupies 36.4% in the gross expenses and the production cost itself remains of the high level in these years. Since domestic agriculture does not shift its place of production, it reflects the price level of the country directly. From this point of view, its may be said that the weakness of Japanese agriculture in cost is structural weakness.





As far as vegetables and fruits are concerned, they are quite different from cereals in the conditions of market, production site, and so forth. Therefore, it is impossible to simply judge their competitive power, but the ratio of labor cost in their production cost is even higher than in the case of rice. This will become a problem in future.

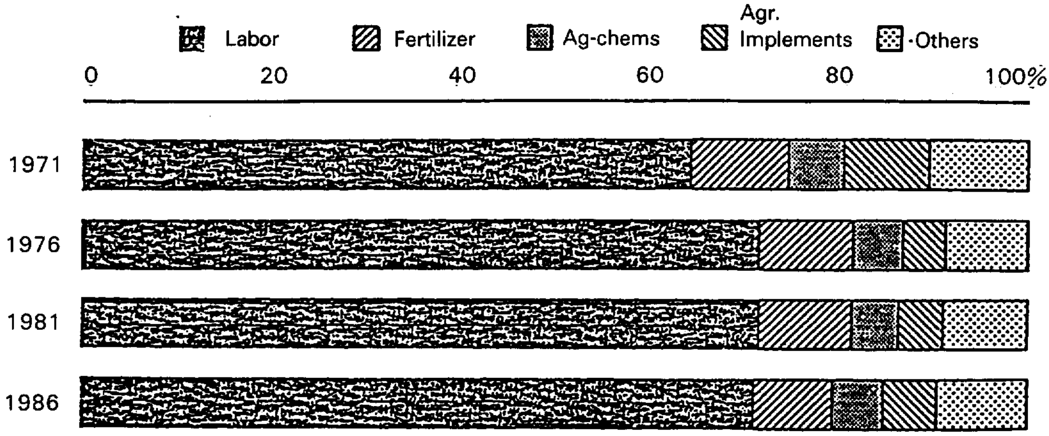
(4) Suburb-type agriculture
—City-style food life

The concentration of the polulation to cities may be common in all countries. In Japan the population concentrates upon the Metropolitan area which consists of Tokyo and its neighboring three prefectures. In 1985 the population of this area reached 31 million, which was 25% of the total population of Japan at that time, and the number is still growing.

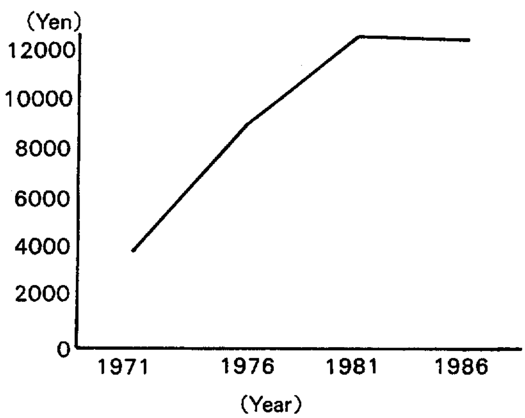
The agricultural products especially vegetables to be supplied to these citizens have to satisfy the

Production Cost of Cucumbers

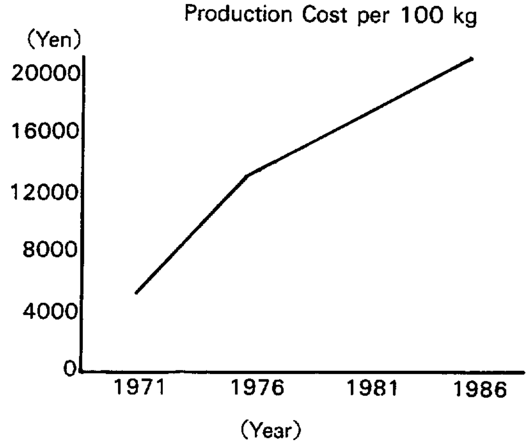
(Component Ratio)



Production Cost per 100 kg



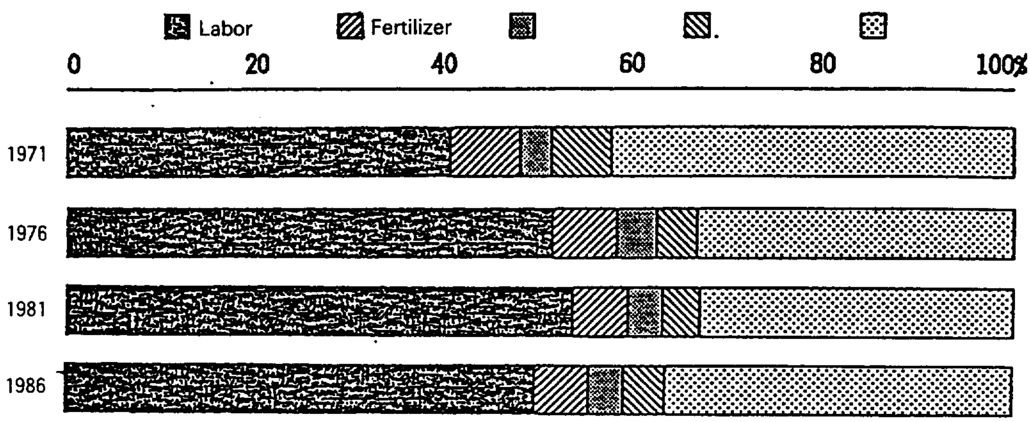
Production Cost per 100 kg

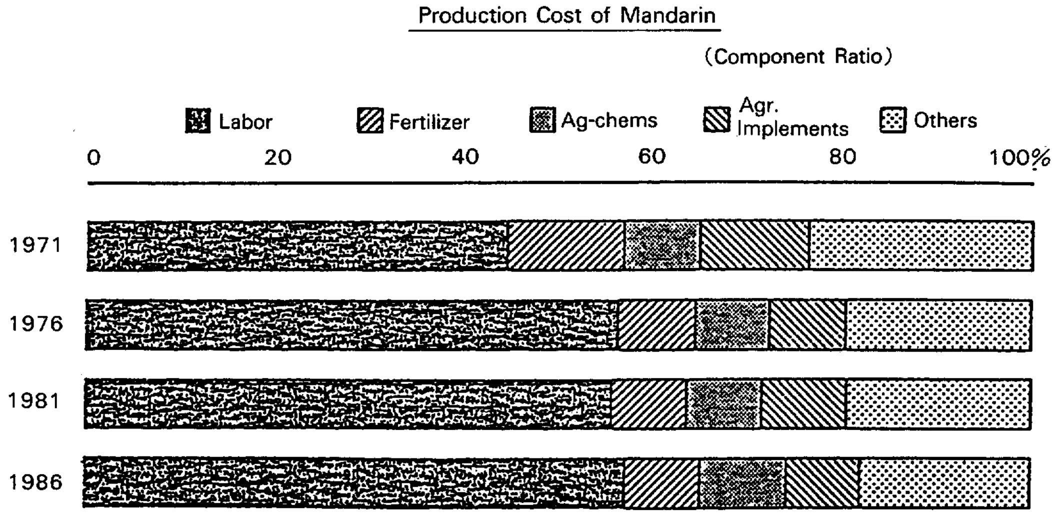


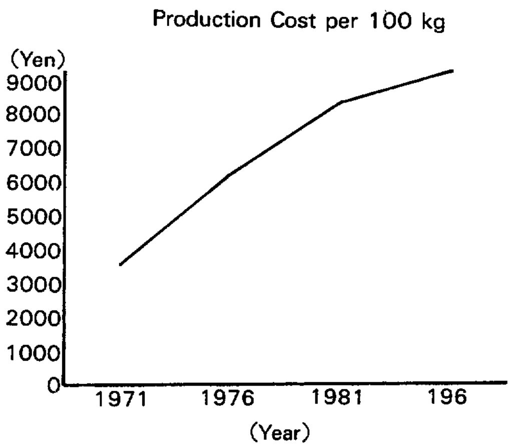
Production Cost of Tomatoes

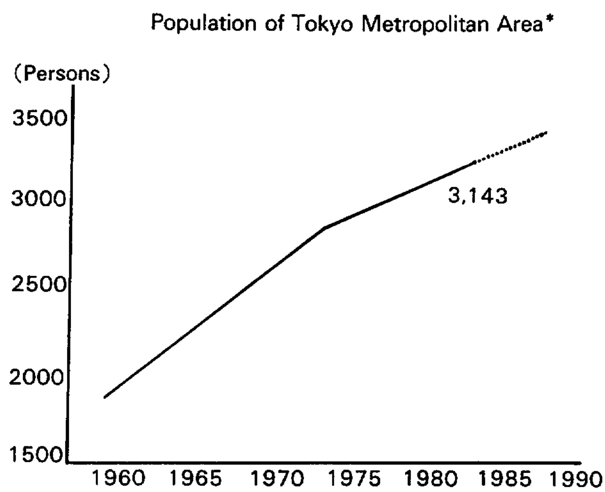
(Forced Cultivation by Greenhouse)

(Component Ratio)









* Tokyo Metropolitan Area includes Tokyo, Kanagawa Pref., Saitama Pref., Chiba Pref. and Tsukuba City of Ibaragi Pref.

(Year)

Priec Index (1985=100)

Year	Wholesale Price*	Retail Price**	Note
1960	42.8	21.2	
1965	43.7	28.3	1st oil panic
1970	48.6	36.9	(1974)
1975	76.2	63.3	
1980	100.5	87.3	2nd Oil Panic
1985	100	100	(1979)
1987	87.5	100.7	

* by the Bank of Japan
** by Statisties Buren

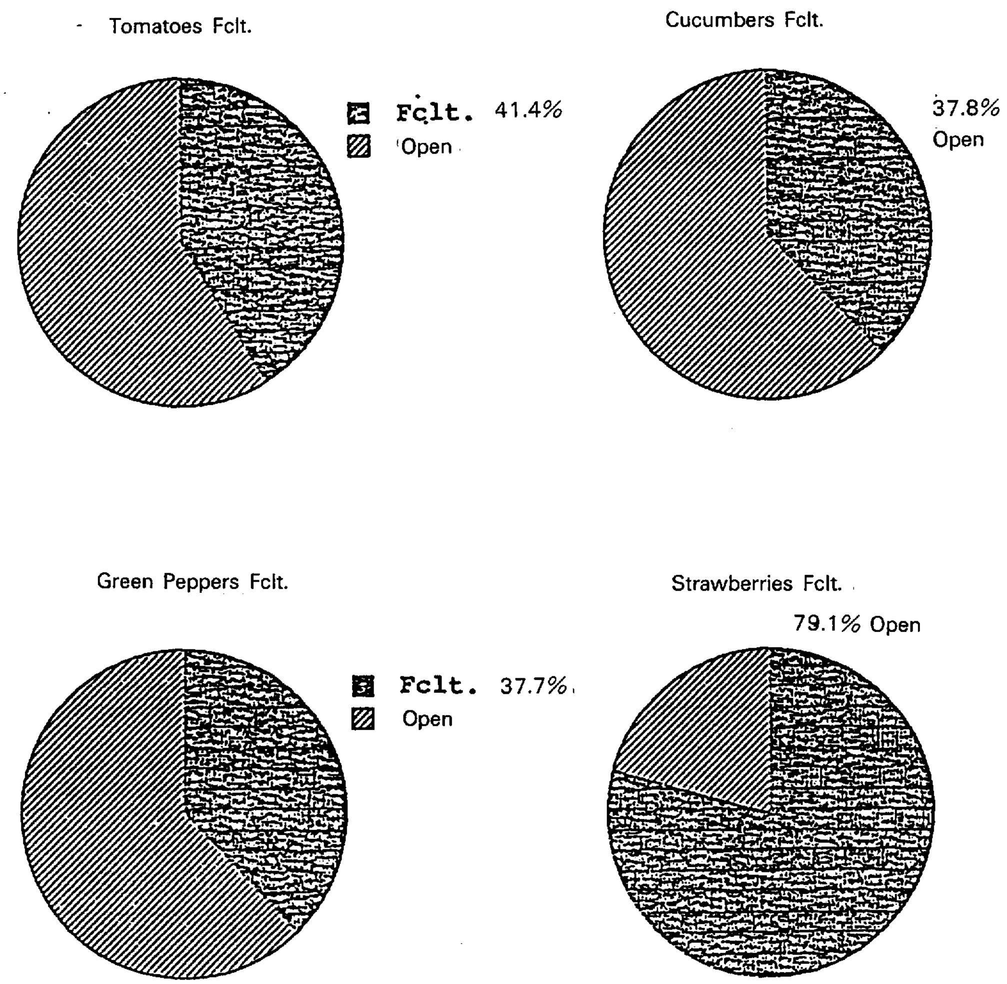
unique pattern of the city-style eating habits in addition to satisfy the basic requirement for enough quantity. Recently it has become possible to produce crops in all seasons as the result of development of greenhouse culturing. On the other hand, food life has been getting more sophisticated in cities. In order to satisfy such need, a large variety of products must be supplied regardless of the season.

Vinyl-covered or glass-house protected culture, mainly producing vegetables

Such vegetables as tomato, cucumbers and strawberries largely depend on protected culture.

The size of protected culture has considerably increased mainly in the Metropolitan area. In spite of the general fall in planted area, the area of protected culture has expanded to almost double for the late ten years.

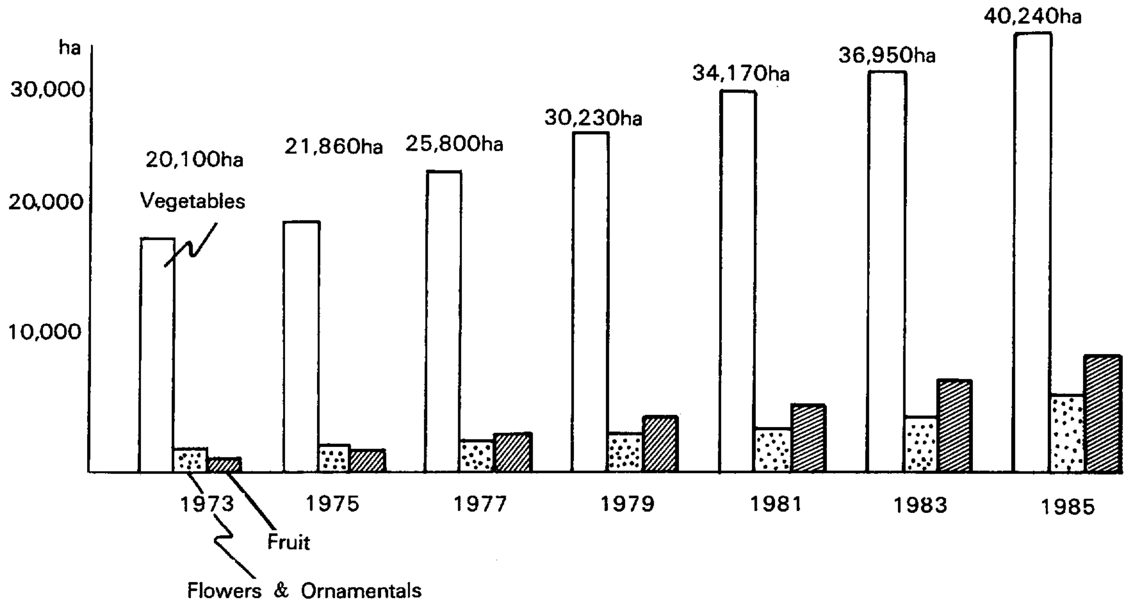
Ratio of Facilities Area to Planted Area
(in 1985)



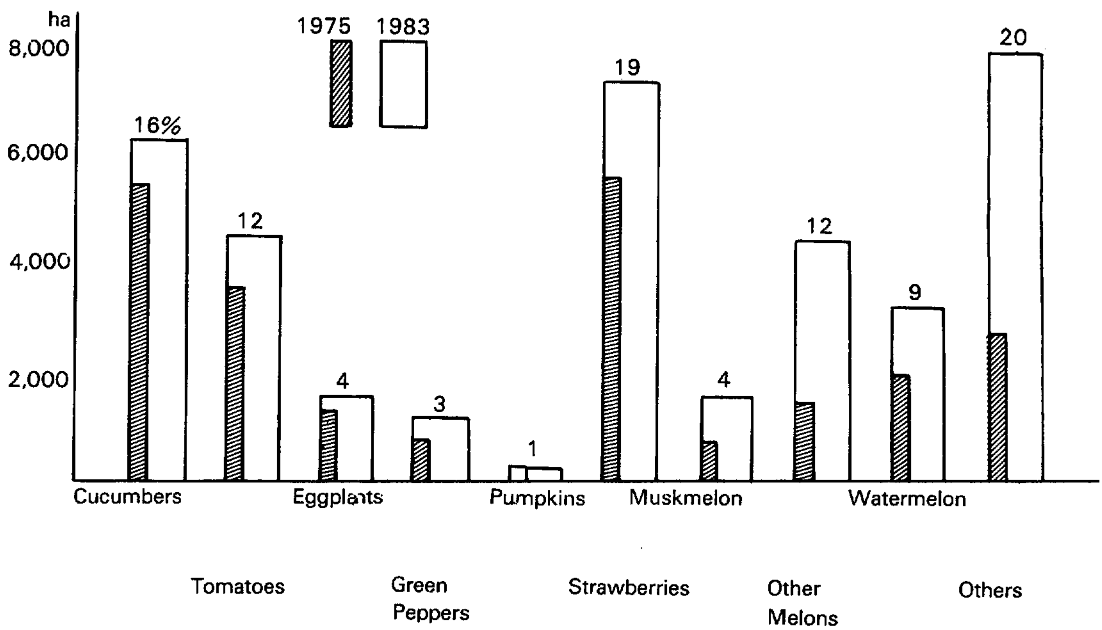
In recent years, not only vegetables but also various kinds of fruit such as grapes, tangerines, etc. have been grown under protedted culture.

Recently hydroponic cultivation has appeared in cities. Protected culture may create a new form of Japanese agriculture.

Transition of Facilities Area



Facilities Area of vegetables



II. Agricultural Chemicals and the Agricultural Chemicals Industry in Japan

(1) Amount of production of agricultural chemicals

— Aricultural chemical registration and the number of agricultural chemicals registered

When we manufacture, import or sell agricultural chemicals in Japan, we must obtain agricultural chemical registration which is stipulated in the Agricultural Chemicals Regulation Law. In order to obtain this registration, we must submit to the authorities data on efficacy test and phytotoxicity test on the chemical. Also, we must submit data on various toxicity tests and residue test for evaluation of its safety. This registration is renewed every three years. At that time, the authorities re-evaluate its safety. If the chemical can not be proved safe, its registration becomes invalid and its production, import or sale is forbidden.

As Table 2-(1)-A shows, the number of agricultural chemicals registered at present is 5,795, out of which 2,575 are insecticides ranking first in number. Then, fungicides and herbicides follow in this order.

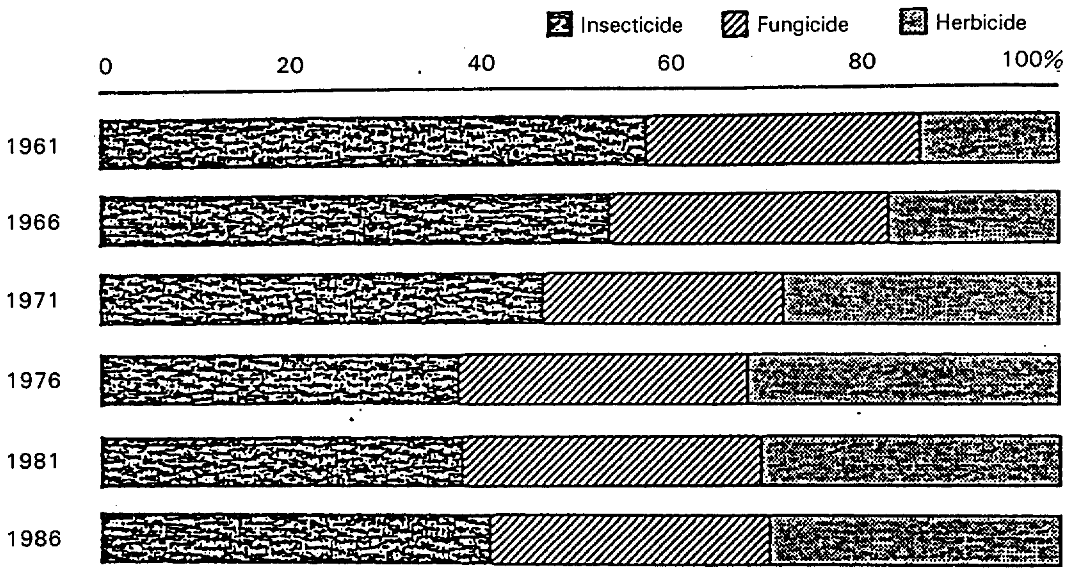
Number of Agricultural Chemicals Registered

Ag-Chem. Yearbook "Noyaku-Yoran" 1988

(As of Sept. 30, 1986)

Insecticide	2,575
Fungicide	1,161
Insecticide-Fungicide Combination	990
Herbicide	671
Pesticide-Fertilizer Combination	1
Rodenticide	88
Plant Growth Regulator	72
Others	237
Total	5,795

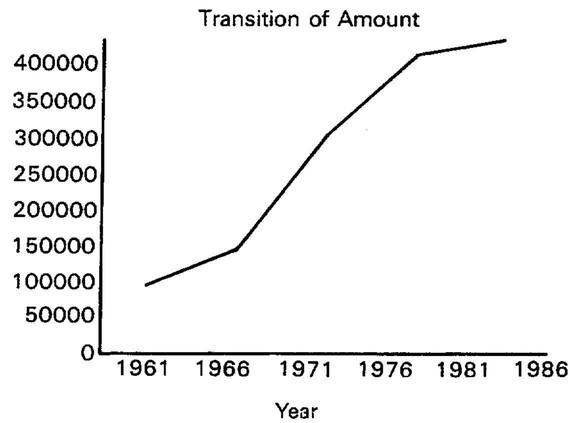
Production Volume of Ag-chems

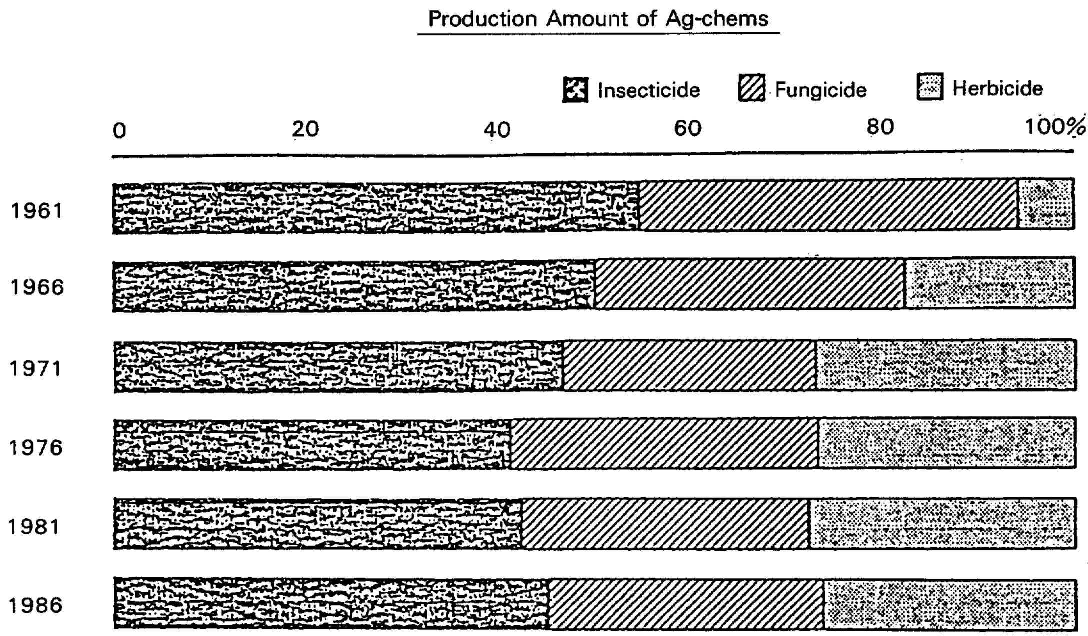


	1961	1966	1971	1976	1981	1986
Insect	16372	30303	43781	80 97	129267	164339
Fung	8272	16469	23715	64955	106563	117523
Herb	4199	10011	26940	69010	105647	121173

— Transition of production by chemical type

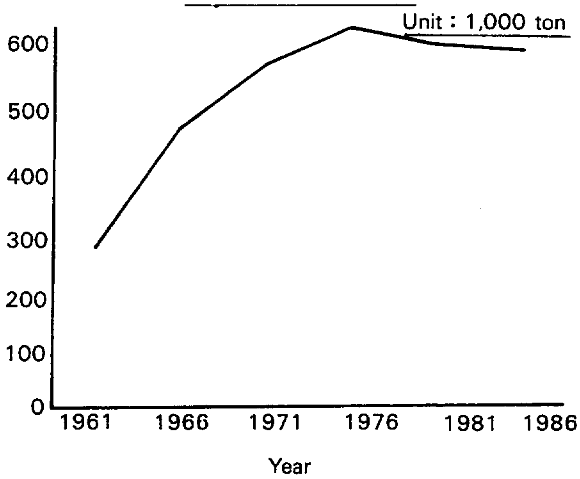
The production of agricultural chemicals in Japan amounted to more than four hundred billion yen in 1986. The production volume, however, almost remains on the same level or even tends to decrease for the recent 10 years. When we look at the production by chemical types of insecticide, fungicide and herbicide, their ratios are almost 4 to 3 to 3 both in value and in volume. However, as you see from the graph, the ratio of herbicide was rather samll until the first half of the 1960's, while insecticide was dominant. In other words, I may say that from the latter half of the 1960's Japanese agriculture turned into the advanced-country-type agriculture where weed control is done with herbicide, not with labor.





	1961	1966	1971	1976	1981	1986
Ineect	149	235	269	263	252	265
Fung	107	150	151	204	177	167
Herb	16	83	156	170	165	154

Transition of Volume

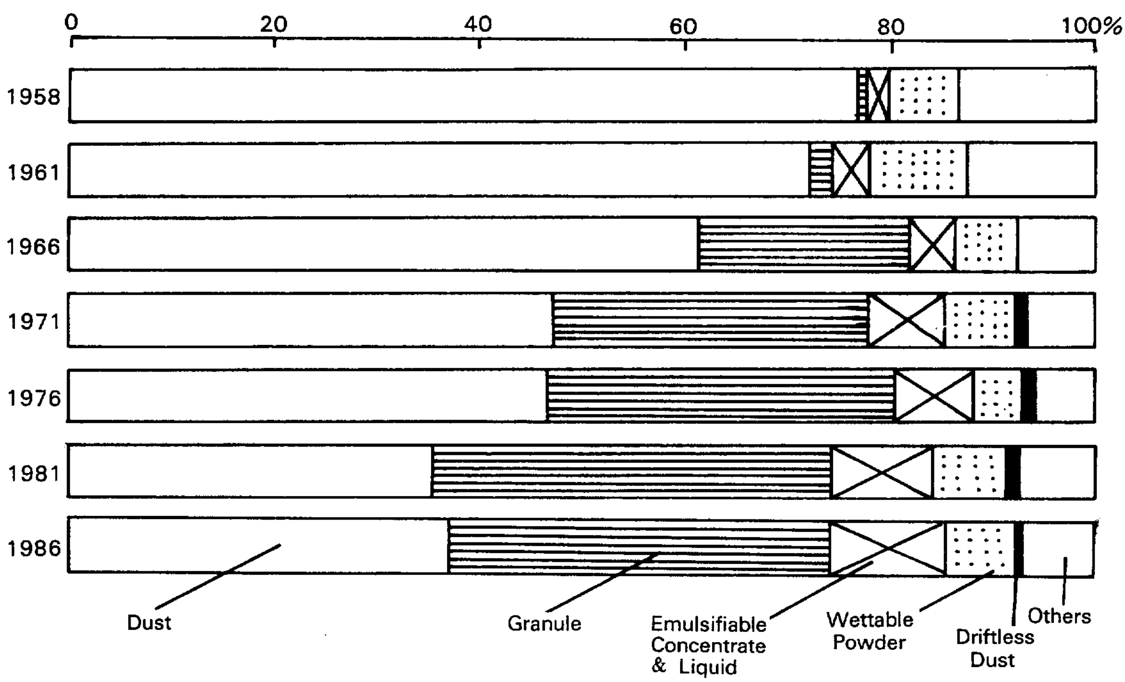


— Transition of production volume by type of formulation

When looking at the production volume of agricultural chemicals by formulation type, we see the production volume of dust formulation has been falling considerably by dirtiness. Demand for formulations is closely connected with operational efficiency, which is influenced by application instruments and methods. The volume of granule formulation increased because its operational efficiency and cleanness were welcomed by farmers.

Recently new application methods, such as application by aircraft, and new agricultural machinery and instruments have been developed. Under such circumstances, it is very likely that demands for new formulation will come out.

Transition of Ag-chem. Production classified by Formulation



(2) Agriculture and environmental problems

— Historical transition

In 1948 the Agricultural Chemicals Regulation Law was established. Since then, agricultural chemicals in Japan have been shifting from inorganic chemicals to organic synthetic chemicals, namely, existing style agricultural chemicals.

In 1948 DDT was registered as an organochlorine insecticide, and in 1949 BHC, a similar insecticide, was also registered. Both of them were applied widely to rice, vegetables, fruits and so forth and contributed greatly for their production.

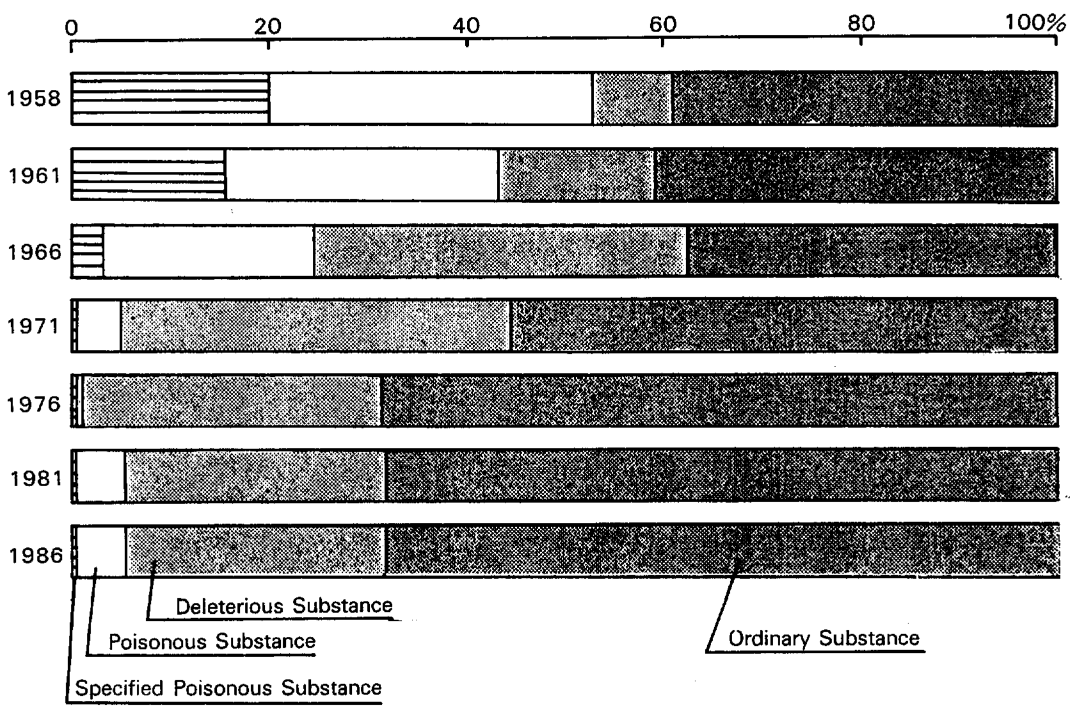
At the beginning of the 1950's TEPP was introduced to Japan and in 1951 Parathion was also introduced. They were organophosphorus insecticides. Parathion in particular fully revealed its efficacy at the outbreak of Rice Stemborer which happened in 1952. However, the toxicity of these two chemicals to man and animal were greater, and a number of lethal accidents occurred. Therefore, the Ministry of Agriculture and Forestry issued a notification in 1967 to forbid their production in 1969. In 1971 their use was completely forbidden with the partial revision of "The Enforcement Ordinance for Poisonous and Deleterious Substances Control Law".

On the other hand, DDT and BHC had a problem of polluting environment. In 1969 production of their technicals was suspended, and in the next year, in 1970, their application to rice was forbidden. In 1971, the Agricultural Chemicals Regulation Law was largely revised. As a result of this revision, the registrations of DDT and BHC became invalid and their sales was completely forbidden.

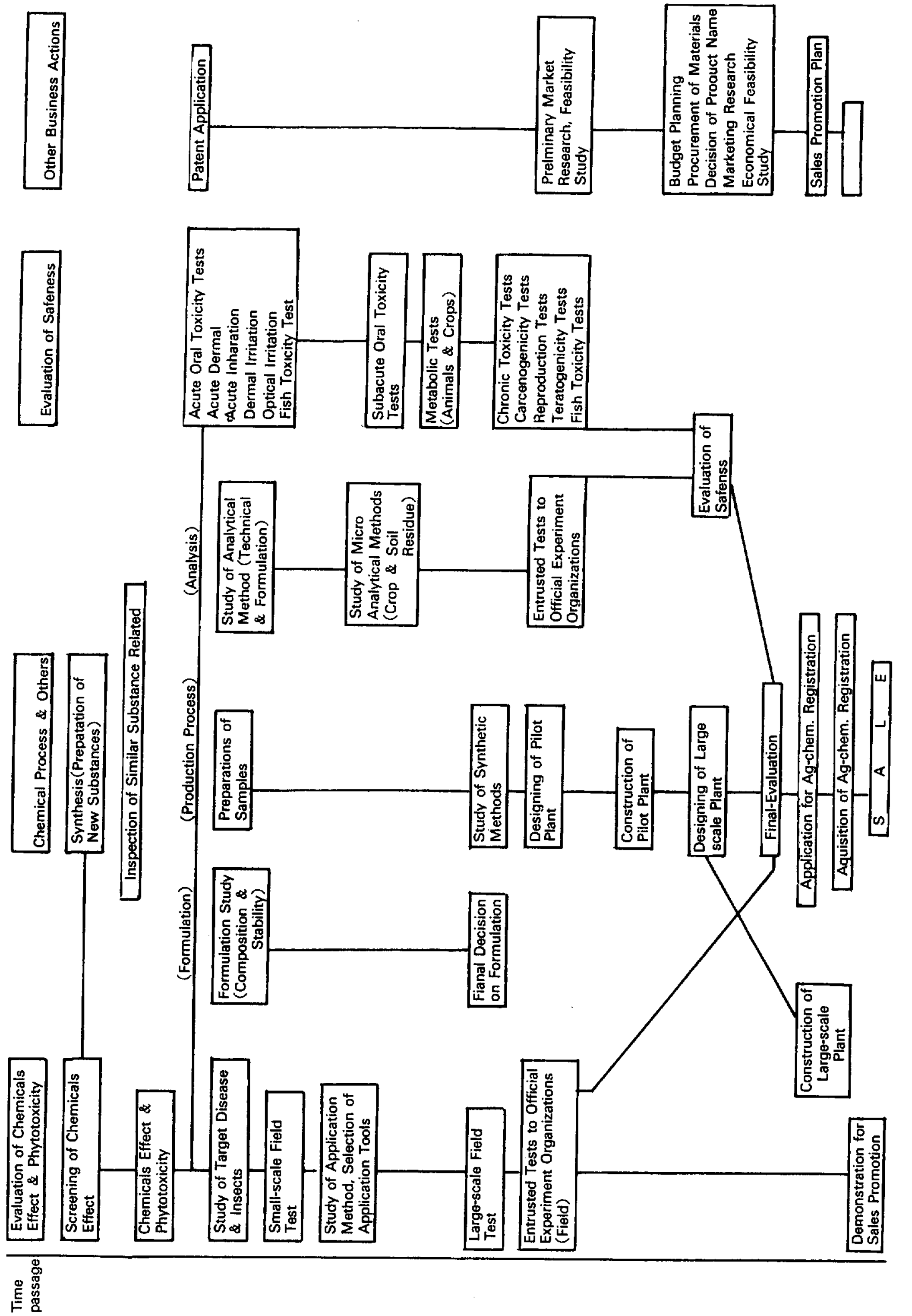
Other agricultural chemicals which appeared one by one in the 1950's also disappered from the market. Dieldrin, Aldrin, organomercurial pesticide, and lead arsenate disappeared because they were designated as soil persistent or crop persistent pesticides. Also, Telodrin, Endrin, Benzoepin, PCP herbicide, and Rotenone disappeared being designated as water pollutant pesticides.

While a series of such strong regulations were taken, development of substitute chemicals with low toxicity was promoted. Let us see the production of

Transition of Ag-chem. Production classified by Toxicity



DEVELOPMENT OF AGRICULTURAL CHEMICALS



agricultural chemicals by toxicity. In 1958 the specified poisonous substances occupied 20%. This ratio remarkably decreased to 0.2% in 1973. Looking at the ratios of poisonous and deleterious substances, we see that the ratio of comparatively low-toxic deleterious substance has increased. The ratio of ordinary substance has increased to occupy 67% of the total production.

(3) Development of agricultural chemicals and safety evaluation

– Development procedure of agricultural chemicals

Development of agricultural chemicals begins with shythesis of a compound which would be the active ingredient. By the way, the number of compounds registered as agricultural chemicals in Japan is 374 and that number of formulations is 5,795.

Number of Compounds registered as Agricultural Chemicals
Ag-chem. Yearbook "Yoyaku-Yoran"

	Insecicide	106
	Fungicide	98
H	Ferbicide	113
	Plant Growth Regulator	29
	Rodenticide	11
	Others	18
	Total	375

When we obtain an expected compound through efficacy screening, we start the evaluation of this compound as agricultural chemical in various fields. In the filed of biology, we examine its efficacy, phytotoxicity and carry out its field tests. In the field of che-

TOXICITY TEST RESULT REQUIRED FOR AG-CHEM. REGISTRATION

Test Item	Registration for Edible Crop	Registration for Inedible Crop	Tests on Tech.	Tests on Product	Remarks
(Acute Toxicity)					
Acute Oral Tox.	○	○	Use two or more kinds of animals	Same as the left	
Acute Dermal Tox.	○	○	Use one or more kinds of animals	Same as the left	
Acute Inharation	○	○	Same as the above	Same as the left	This test should be conducted to ag-chems. possibly exposed to throat, like gas or volatile type ones
Primary Optical	○	○	X	Use one or more kinds of animals	When it is dfficult to test formulation, the use of technical for the test is allowed.
Primary Dermal Irritation	○	○	X	Same as the above	Same as the above
Dermal Suscepti bility Test	○	○	X	Same as the above	Same as the above
Acute Slow-action	○	○	Test by Chicken	X	This test should be conducted to ag-chems. possible to cause an inhibition of colin-esterase

Test Item	Registration for Edible Crop	Registration for Inedible Crop	Tests on Tech.	Tests on Product	Remarks
(Subacute Toxicity)					
Subacute Oral Tox.	○	○	Use one or more kinds of animals inedible, or two or more kinds of animals edible	X	
Subacute Dermal Tox.	△	△	Use one or more kinds of animals	X	
Subacute Inharation Tox.	△	△	Same as the above	X	
Subacute Neurotoxic Test	△	△	Test by Chicken	X	
(Long-term Toxicity)					
Chronic Tox.	○	△	Use two or more kinds of animals(one rodent and one non-rodent animals at least)	X	
Carcinogenicity Test	○	△	Use one or more kinds of animals	X	
Reproduction Test Test	○	△	Use one or more kinds of animals	X	

Test Item	Registration for Edible Crop	Registration for Inedible Crop	Tests on Tech.	Tests on Product	Remarks
Teratogenicity Test	○	○	Use two or more kinds of animals (one of which) should be the same as that used for reproductin test)	X	
Mutagenicity Test	○	○	—	—	
(Others)					
Intra-body Fate Examination Tests	○	○	—	—	
Tests on Effect to Living Body Function	○	○	—	—	

(note) ○ : obligated to be presented at the time of registration application

△ : To be presented when instructed by Government Office

X : not needed

— : not designated in this list

mistry, we examine its formulation, manufacturing process and carry out its analysis. In connection with safety, we carry out various toxicity tests and residue tests. However, we have to spend at least 8 years and a huge amount of money, say about billions of yen, to reach the filing of the application for registration. Even if we have spent such time and money, it is said the probability that we can commercialize the developed compound is 1/20,000.

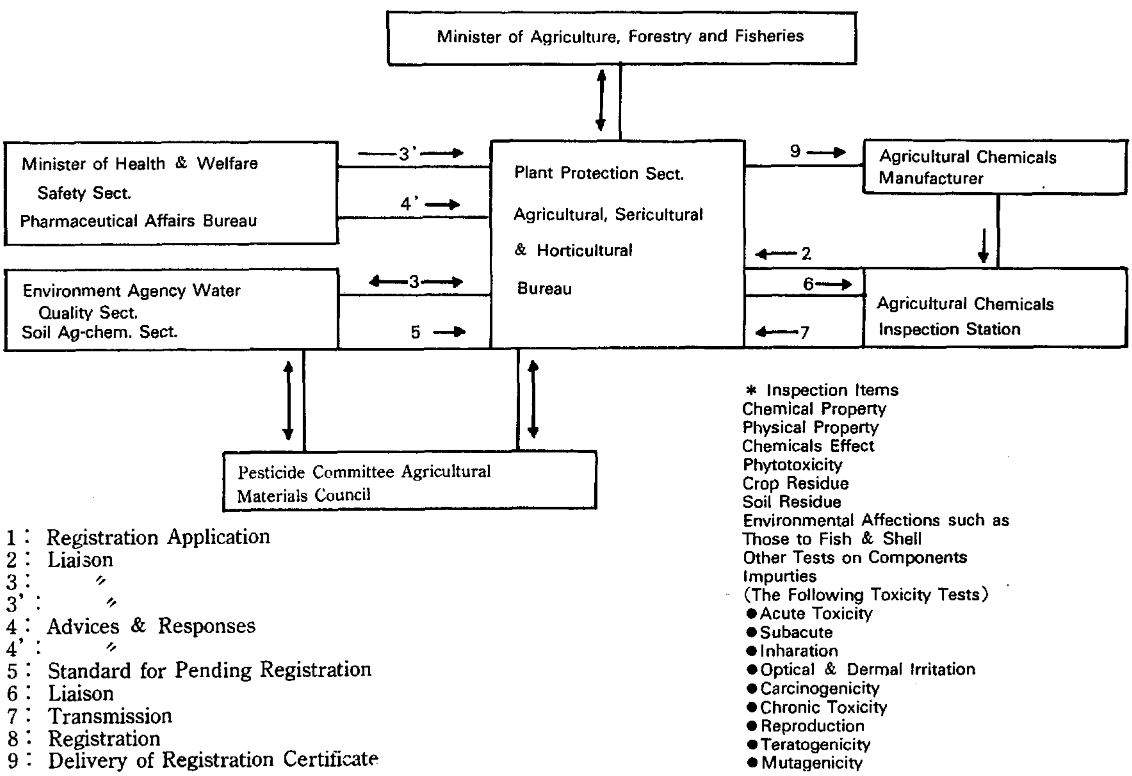
— Safety evaluation of agricultural chemicals and registration procedure

Recently our society has more and more growing concren in safety of agricultural chemicals. For their evaluation, we are required to submit data which would prove their safety concerning various toxicity tests, teratogenicity test, carcinogenicity tests and so on. These dada are required not only at the time of registration of new chemicals but at the time of renewal of the registration of existing chemicals.

Let me show you a list of tests required for safety evaluation and average costs needed for efficacy, phytotoxicity and residue tests.

An applicant submit to the Agricultural Chemicals Inspection Station of the Ministry of Agriculture, Forestry and Fisheries an application sheet together with all the required data. The Inspection Station passes a copy of the submitted document to the Ministry of Health and Welfare and to the Environment Agency through the Plant Protection Division, keeping one copy for itself. Further, the Inspection Station consults with the Agricultural Materials Council

System of Ag-chem. Registration & Safety Evaluation

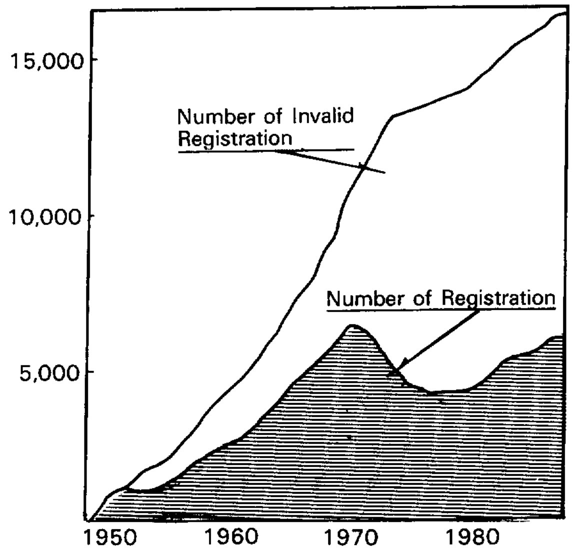


on the document, After each division in charge completed examination of the document and no problem was found on the chemical concerned, then the Plant Protection Division collects the examination results together. Finally, the Minister of Agriculture, Forestry and Fisheries grants the applicant a license for agricultural chemical registration.

— Products whose registrations became invalid

As I mentioned earlier, enormous expense is required not only at the time of registration of a new drug but also at the time of renewal of the registration of existing chemical, because we have to carry out various expensive tests for re-evaluation of its safety.

It is quite natural that a company which has registered a chemical worries about at the time of rene-



Transition in Number of Ag-chems. Registered

TOCIL's Ag-Chems. discontinued/expired

Common Name	Registerted Name	Date of Discontinuation Expiry
Organomercury	PTA-BEC	Jan. 30, 1969
TOPE	Attackweed EC	May 1, 1972
BHC-Nitrofen	r-NIP-Q Gra	Jun. 20, 1972
Polycarbamate	Bis-Dithane Dust	Jun. 12, 1973
Nitrofen-MCP	NIP-Q Gra	Jun. 12, 1973
Mancozeb	Ziman-Dithane Dust	Jun. 5, 1974
Amobam-Dimethylamobam	Bis-Dithane Stainless	Jun. 7, 1974
Dimethylamobam	Carbamysol	Jun. 7, 1974
MCP	Matsubain	Aug. 15, 1974
Polycarbamate-DPC	Bis-Dithane-K WP	Aug. 25, 1974
TOPE	Attackweed Gra	May 1, 1975
Carbam	Biomate Dust	May 8, 1975
Nitrofen-MCP	NIP-QP Gra	Feb. 28, 1976
Diazinon-Nitrofen	Diazinon-NIP Gra	Mar. 31, 1979
piriminil	Nezuthane	Jul. 14, 1981
Nitrofen-Dymron	Tolrone Gra	Sept. 29, 1981
Nitrofen	Hatasaku-NIP Gra	Mar. 7, 1982
Nitrofen	NIP WP	Mar. 31, 1982
Nitrofen	NIP EC	Jun. 28, 1982
Nitrofen	NIP Gra	Jun. 28, 1982

Main Ag-Chems. developed in Japan

Registered as of Dec., 1985

	Common Name	Registered Name	Developed by :
1. Insecticide			
(1) Organophosphorus insecticide			
	CYAP	Cyanox	Sumitomo Chem.
	MEP	Sumithion/Accothion Metathion/etc.	Sumitomo Chem.
	Isoxathion	Karphos	Sankyo
	Pyridaphenthion	Ofunack	Mitsui Toatsu Chem.
	Prothiofos	Tokuthion	Nihon Tokushu Noyaku Seizo
	Propaphos	Kayaphos	Nihon Kayaku
	Salithion	—	Kyushu Univ.
(2) Carbamate insecticide			
	MTMC	Tsumacide/Metacrate	Nihon Nohyaku
	MIPC	Mipcin	Mitsubishi Kasei
	BPMC	Bassa/Osback/etc.	Kumiai Chem.
	MPMC	Meobal	Sumitomo Chem.
	XMC	Macbal	Hodogaya Chem. /Hokko Chem.
(3) Synthetic Pyrethroids insecticide			
	Fenvalerate	Sumicidin	Sumitomo Chem.
(4) Acaricide			
	Benzomate	Citrazon	Nippon Soda
	Polinactins	Mitecidin	Chugai Pharm.
(5) Nematicide			
	DCIP	Nemamolu	Showa Denko
	Mesulphenphos	(Nemanone)*	Nihon Tokushu
(6) Other insecticides			
	Buprofezin	Applaud	Nihon Nohyaku
	DCV	(Matsukemin)*	Chugai Pharm.

	Common Name	Registered Name	Developed by :
2. Fungicide			
(1) Organic Copper fungicide			
	Copper hydroxy -nonylbenzensulfonate	Yonepon	Yonezawa Chem.
	DBEDC	(Sanyol)*	Sanyo Chem. (Yonegawa Chem. at Present)
(2) Organic Sulfur fungicide			
	Amobam	Dithane Stainless	Tokyo Org. Chem.
	Polycarbamate	Bis-Dithane	Tokyo Org. Chem.

	Nickel dimethyl -dithiocarbamate	Sankel	
(3) Organochlorine fungicide			
	Fthalide	Rabcide	Kureha Chem.
(4) Organophosphorus fungicide			
	IBP	Kitazin P	Ihara Ag. Chem. (Kumiai Chem. at present)
	Tolclofosmethyl	(Granser)*	Sumitomo Chem.
(5) Benzimidazole fungicide			
	Thiophanate -menthyl	Topsin M	Nippon Soda
(6) Dicarboximido fungicide			
	Procymidone	Sumilex	Sumitomo Chem.
(7) Antibiotic preparation			
	Kasugamycin	Kasumin	Hokko Chem.
	Polioxins	Polyoxin	IPCR
	Validamycin	Validacin	Takeda Chem.
	Novobiocin	Novobiocin	IPCR/Meiji Seika
	Mildiomycin	Mildewmycin	Takeda Chem.
	Common Name	Registered Name	Developed by :
(8) Soil disinfectant			
	Carbam	NCS	Tokyo Org. Chem.
	Hydroxyisoxazole	Tachigaren	Sankyo
(9) Other fungicides			
	Phenazine Oxide	Phenazine	Meiji Seika
	Mepronil	Basitac	Kumiai Chem.
	Probenazol	Orzemate	Meiji Seika
	Iso-prothiolane	Fuji-One	Nihon Nohyaku
	Methasulfocarb	Kayabest	Nihon Kayaku
	Fluoroimide	Spartcide	Mitsubishi Kasei /Kumiai Chem.
	Guazatine	Beflan	Dainippon Ink Chem.
	Lecithin	Lecithinon	IPCR/Ajinomoto /Kumiai Chem. /Nihon Nohyaku /Zennoh
	Sodium Alginate	Mozanon	Mitsubishi Kasei
	Trichoderma Lingnorum	—	Sanyo Yakuhin
	Extract of dentinus —edodes-mycelia	(Lentemin)*	Noda Shokukin
	Sodium Acid Carbonate	(Nosuran)*	IPCR

3. Herbicide

(1) Phenoxy herbicide

	Common Name	Registered Name	Developed by :
	Phenothiol	(Grakil)*	Hokko Chem.
	Naproanilide	Uribest	Mitsui Toatsu Chem.
(2) Diphenylether herbicide			
	CNP	MO	Mitsui Toatsu Chem.
	Chlormethoxynil	X-52/Diphenex	Ishihara Sangyo /Nihon Nohyaku
(3) Carbamate herbicide			
	Benthiocarb	Saturn	Kumiai Chem.
	Orthobencarb	Lanray	Kumiai Chem.
(4) Urea herbicide			
	Dymron	Showron	Showa Denko
	Methyldymron	Stacker	Showa Denko
(5) Diazole herbicide			
	Oxadiazon	Ronstar	Rhone-Poulenc /Nissan Chem.
	Pyrazolate	Sanbird	Sankyo
(6) Fatty Acid herbicide.			
	TCA	(Gelbar)*	Japan Carlet
	Tetrapion	Frenock	Daikin/Sankyo
(7) Organophosphorus herbicide			
	Amiprofosmethyl	Tokunol M	Bayer/Nihon Tokushu Noyaku Seizo
	Butamifos	Tafler/Cremart-U	Sumitomo Chem.
	SAP	(Lonper/Jeisan)*	Nihon Nohyaku
	Bialaphos	Herbiace	Meiji Seika
(8) Other herbicides			
	Acephenon	(Castite)*	Dainippon Ink Chem.
	Alloxydim	Kusagard	Nippon Soda
	Chlorphthalim	Diamate	Mitsubishi Kasei
4. Rodenticide			
	Liquiefied Nitrogen	—	Nissan Shoji
	Bisthiosemi	Kayanex	Nihon Kayaku
5. Plant Growth Regulator			
	Ethychlozate	Rutiace/Figaron	Nissan Chem. /Fujisawa Pharm.
	Gibberellins	—	MAFF/Tokyo Univ.
	Nicotinic Acid Amide	(Kakentamin)*	IPCR
	Silicon Dioxide	Shionox	Shionogi
	Piperonyl -butixide	Butox	Takasago Int.

spelled as phonetically

wal whether it will be able to recover the testing expenses for the re-evaluation. The company may give up the renewal, if the registered chemical is a minor product or there is some doubt about its safety.

Our company is manufacturing agricultural chemicals. Principally they are EBDC fungicides. Since 1971 when the full-scale revison of the Agricultural Chemicals Regulation Law took place, our company has given up renewal of the registrations of minor products which can not bear the burden of the testing expenses.

— Major agricultural chemicals developed in Japan

(4) Development of agricultural chemicals at TOCIL

Since its establishment in 1957, our company has continued production of Dithane, dithiocarbamate group fungicide. Its production technology was introduced from Rohm and Haas Co. in the U.S., our parent company. At the same time, we have pursued our own research and development based on the Dithane production. As a result, we have developed a lot of patents as shown in Table 2-(4)-B. Among the patents included are such minor products as Biomate and Carbamysol, for these products, we have given up the renewal of the registrations. But the other products are still sold now.

TOCIL's Ag-chems. List

Registered Name	Common Name	Date of Registration
Dithane wp	Zineb	Dec. 13, 1969 (May 31, 1958)*
Dithane Stainless	Amobam	Apr. 30, 1960
NCS	Carbam	May 27, 1964
Bis Dithane-wp	Polycarbamate	Dec. 13, 1969 (Mar. 10, 1965)*
Stam EC 35	Propanil	Jun. 23, 1965
Dithane Dust	Zineb	Nov. 10, 1965
Maneb-Dithane M WP	Maneb	Dec. 13, 1969
Ziman-Dithane WP	Mancozeb	Dec. 13, 1969
Liquid Dithane	Amobam	Feb. 14, 1973
Bis-Dithane FD	Polycarbamate	Aug. 24, 1982
Zimanlex WP	Procymydone -Mancozeb	Nov. 30, 1983
Rovziman WP	Iprodione -Mancozeb	Jul. 11, 1984
Aliziman WP	Fosetyl-Al -Mancozeb	Sept. 28, 1984
Ronilanzeb WP	Vinclozolin -Mancozeb	Apr. 14, 1986
Ridomil MZ WP	Mancozeb-Metalaxyl	Oct. 28, 1986
Sandofan M WP	Oxadixyl-Mancozeb	Oct. 28, 1986

*Date of Initial Registration

TOCIL's Ag-Chem. Patent

Product Name	Japanese Patent No.	Title
Dithane-Stainless	271919	Insecticidal Fungicide
	278998	Agricultural Chemicals improving disease registant of plants.
	280999	Stable Agr.-horticultural Chemicals which have insecticidal-fungicidal actions and improve disease registant of plants.
Bis Dithane	283168	Agr.-horticultural composition for killing noxious organisms.
	287794	Manufacturing Process of Dithicarbamic Acid mixed Salts.
NCS	297550	Stable Agr.-horticultural Chemicals which have insecticidal nematocidal fungicidal and herbicidal actions.

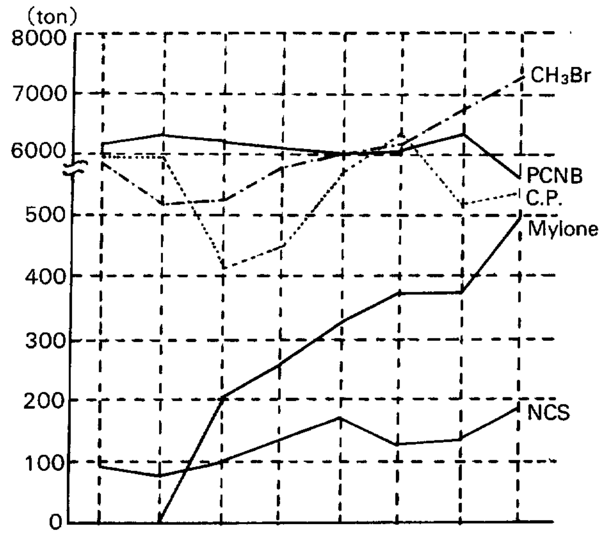
TOCIL's Ag-chem. patent(Cont'd)

Product Name	Japanese Patent No.	Title
Carbamysol	317349	Soil Infectant
	312588	Fungicidal-Insecticide for Agr.-horticultural purposes.
Biomate	450606	Fungicidal-Insecticide for Agr.-industrial purposes.
PS-II	417872	Chemical composition for killing noxious plants in water.
MITC	317436	Agr.-horticultural chemicals which has insecticidal-fungicidal-nematicidal-ovicidal actions.
Borcon	690265	Fungicidal-Algicide for non-medical purposes.
	936105	Fungicide for non-medical purposes.

In addition to the new agricultural chemicals, we have also developed application methods and formulations. For example, we created a new merket for TOK by developing formulation technology. Initially TOK was sold in emulsion formulation in various countries, but we succeeded in manufacturing TOK granule to be applied to paddy fields as herbicide.

One of the recent examples is development of a new application method for NCS. This compound, which we developed as a soil treating agent, did not sell well for a long time, because its treatment process did not fit application machinery well. Now with the new application method using a tractor, the operational efficiency and safety of this water-soluble soil treating agent have been greatly improved. The idea to cherish soil or to make an investement in soil consitutes a part of the new trend in agriculture. I hope that the new application method of NCS will be accepted widely by farmers.

Shipping Volume of Soil Disinfectant



	1980 s-55	1981 56	1982 57	1983 58	1984 59	1985 60	1986 61	1987 62
PCNB	6136	6402	6166	6090	6033	6056	6392	5636
C. P	5961	5967	4221	4549	5736	6335	5161	5334
CH_3Br	5806	5237	5276	5979	5987	5197	6740	7341
NCS	93	73	100	132	173	130	135	190
My lone	0	0	198	255	329	370	366	497

(5) Manufacturing plants of agricultural chemicals and related laws and regulations

I have so far talked about the safety and the controlling regulations of agricultural chemicals themselves. Now I would like to talk a little about their manufacturing plants and the related laws and regulations.

To tell the conclusion first, there is no substantial difference between agricultural chemicals manufacturing plants and ordinary chemical plants, though their scales may differ. They are subject to :

- "the Plant Location Law" and "the Town Planning and Zoning Act" at the time of location, and
- "the Environmental Pollution Prevention Act" in connection with pollution, and
- "the Poisonous and Deleterious Substances Control Law"

and a number of other regulations mainly relaing to preservation of the environment.

III. My Personal View on the Future of Agricultural Chemicals

1. Agrochemicals are essential for human being both at present and in future. The reasons are

Laws and Ordinances Related to Prevention of Public Nuisances

Basic Laws Concerning Public Nuisance Control	Entrepreneur's Responsibility	· Law Concerning the Establishment of Public Nuisance Prevention Organization in the Specific Factories · Law Concerning Entrepreneur's Responsibility for Public Nuisance Prevention Cost
	Restriction and Others	· Air Pollution Control Act · Water Quality Contamination Prevention Act · Marine Pollution Prevention Act · Ordinance on the Prevention of Soil Pollution of Farmland · Noise Control Act · Vibration Control Act · Industrial Water Act · Law Concerning the Restriction for Collecting the Underground Water for Construction · Stench Prevention Act
	Installment of Pollution Prevention Facilities	· Special Measure on the Installation of Waste Treatment Facilities · Ordinance on Waste Treatment and Cleaning · Sewage Act.
	Nature Protection	· Natural Environment Protection Act · Natural Park Act
	Restriction to Land Use	· National Land Consolidated Development Act · City Planning Act · Industry Control Act for Existing Urban District in Metropolitan Area · Plant Location Act
	Encouragement Measures for Public Nuisance Control	· Law Concerning Special Measure on National Financial Aid for Enterprises Related to Public Nuisance Prevention Works · Law Concerning Public Nuisance Prevention Corporation
	Treatment	· Pollution-related Health Damage Compensation Act · Pollution-related Conflict Disposal Act
	Public Nuisanc Crime	· Health-related Pollution Crime Punishment Act

that (1) the population in the world will more and more increase, (2) the area for agriculture is limited and therefore (3) the improvement in crop productivity must be attained by all means.

Agrochemicals should be harmless to human body for lifelong and generations, and should not be destructive of the environment of nature and human life.

We should also continue following studies and find some technology to fill the above requirements. This technology would be a sort of macro-science and is gigantic, but meaningful and necessary for us. The development of this technique probably includes

(1) extensive screening tests of chemical compounds,
(2) extensive studies on its formulation and application methods and machines, (3) complete survey on toxicological and ecological problems, and so on.

2. I may pick up some more practical points from personal viewpoint as follows just for your reference :
   (1) New chemicals-be applicable at less dosage, easy to disappear after action, not-toxic, etc.
   (1) Re-investigation to some new formulations of existing chemicals, well-known and safer ones to attain more effective coverage of only for target parts compared with existing formulation.
   (2) Improvement of application method (mechanical)-less chemicals to cover big area, safer application, etc.
3. Through the drastic development of technology now under way, the form of the present food production might change greatly in future. For example,
   (1) New growing methods based on new bio-technology including mericlone and hydroponic culture, the production of new varieties of crops and so on.
   (2) The development in transportation, storage and processing of crop, etc. might have a possibility to change the circumstances of agriculture in future and eventually recolor the agricultural world-map.