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① 合同評価報告書

AGREEMENT OF THE JOINT EVALUATION REPORT ON THE MAIZE QUALITY IMPROVEMENT RESEARCH CENTER PROJECT IN THE KINGDOM OF THAILAND BY THE KINGDOM OF THAILAND-THE JAPAN INTERNATIONAL COOPERATION AGENCY

With about five months left before termination of the Project on December 14, 1991, the Japanese Evaluation Team visited Thailand from July 14 through July 26, 1991. The team was organized by the Japan International Cooperation Agency (hereinafter referred to as JICA) and led by Dr. Masaru Manabe, Director, Department of Applied Microbiology, National Food Research Institute, Ministry of Agriculture, Forestry and Fisheries.

The aim of the visit was to make a comprehensive evaluation of the Maize Quality Improvement Research Center Project in Thailand (hereinafter referred to as the Project).

The evaluation was carried out jointly with the Thai Evaluation Team led by Dr. Arwooth Na Lampang, Field Crops Specialist, the Department of Agriculture, Ministry of Agriculture and Cooperatives (hereinafter referred to as DOA and MOAC, respectively).

The teams interviewed the Japanese experts and Thai counterparts assigned to the Project, had a series of discussion with Thai authorities concerned, made field surveys and exchanged views and ideas.

As a result, both teams agreed to forward to their respective governments a summary of the evaluation and of recommendations which is referred to in the document attached hereto.

Bangkok, July 24, 1991

Masaru Manabe

Dr. Masaru Manabe
Leader
Japanese Evaluation Team
Japan International
Cooperation Agency

A. Na Lampang

Dr. Arwooth Na Lampang
Leader
Thai Evaluation Team
Ministry of Agriculture
and Cooperatives

Tanongchit Wongsiri

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Director of General
Department of Agriculture
Ministry of Agriculture
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CONTENTS OF THE JOINT EVALUATION REPORT

ATTACHMENT

1. INTRODUCTION

Aflatoxins belong to mycotoxins which some fungi produce. They are highly toxic and carcinogenic substances. Aspergillus flavus (hereinafter referred to as A. flavus) is a fungus which produces aflatoxins. It contaminates peanuts, cottonseed, tree nuts and grain sorghum as well as maize during harvest, processing and storage.

Maize contaminated by aflatoxin was recognized as a crucial issue in Thailand. This is because maize was the major export item of Thailand (see Appendix 1). The Maize Development Project which lasted for eight years since 1976 under Japan-Thailand cooperation addressed the issue partly.

In 1984, therefore the Thai Government again requested technical cooperation from the Japanese Government for maize quality improvement. On December 15, 1986, representatives of both governments signed the Record of Discussions (hereinafter referred to as R/D) and thus the Maize Quality Improvement Research Center Project has started.

The Project aims to strengthen research activities and develop appropriate technics, thus contributing to the improvement of maize quality by controlling aflatoxin contamination. Towards the target, the project has carried out three research items below.

(1) Analysis of contamination factors
(2) Improvement of test technics
(3) Countermeasure of aflatoxin prevention

The Project has been conducted mainly at the Maize Quality Improvement Research Center (hereinafter referred to as the Center) and Phra Phutthabat Field Crop Experiment Station (hereinafter referred to as the Station). The Center was consolidated under the Japanese Grant Aid Program agreed upon between the two governments by the Exchange of Notes in 1987.

As the cooperation will complete in about five months, both governments agreed to carry out a joint evaluation of the Project.

2. PURPOSE OF THE EVALUATION

(1) To make a comprehensive evaluation of the performance as compared with the cooperation schedule and target.

(2) To make recommendations to the authorities of the two governments concerned after the end of the Project period.

(3) To feedback results to both policy-makers and operational staffs so that future projects can be improved.

3. STUDY ITEMS

(1) Input of Supporting Activities
  1) Contribution of the Government of Japan
    A. Assignment of Japanese experts
    B. Provision of machinery and equipment
    C. Training of Thai counterparts in Japan
    D. Others
  2) Measures taken by the Government of Thailand
    A. Provision of land, buildings and facilities
    B. Assignment of counterparts and other personnel
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(2) Research Highlights
  1) Agronomy
  2) Post-harvest
  3) Microbe
(3) Impacts of the Project
(4) Management of the Project
(5) Conclusion and recommendations

4. MEMBERS LIST

4.1. The Japanese Evaluation Team

(1) Dr. Masaru Manabe: Leader, Microbe
Director, Department of Applied Microbiology, National Food Research Institute, Ministry of Agriculture, Forestry and Fisheries (MAFF).

(2) Mr. Tomio Ohkura: Cooperation Effect
Chief of Technical Cooperation, International Research Division, Agriculture, Forestry and Fisheries Research Council, MAFF.

(3) Mr. Kazuaki Amari: Post-harvest
Seed Inspector, Forage Crop Division, Livestock Industry Bureau, MAFF.

(4) Dr. Fumio Ikegaya: Agronomy
Chief of Corn Breeding Laboratory, Department of Upland Farming, Kyushu National Agricultural Experiment Station, MAFF.

(5) Mr. Jiro Iida: Coordinator
Staff, Development Planning Division, Agriculture, Forestry and Fisheries Planning & Survey Department, JICA.

4.2. The Thai Evaluation Team

(1) Dr. Arwooth Na Lampang: Leader
Field Crops Specialist, Department of Agriculture (DOA), Ministry of Agriculture and Cooperatives (MOAC).

(2) Mr. Sompark Siddhipongse
Plant Pathology Specialist, DOA, MOAC.

(3) Mr. Kumnuan Tunpun: Assistant Professor
Faculty of Engineering, Kasetsart University.

(4) Dr. Utai Pisone
Director of Foreign Agricultural Relations Division, Office of

the Permanent Secretary, MOAC.

(5) Ms. Pathara Chor-sorapongs
Director of Evaluation Divisiion, Bureau of the Budget, Office of the Prime Minister.

(6) Mr. Pipat Purnananda
Budget Analyst 7, Evaluation Division, Bureau of the Budget, Office of the Prime Minister.

5. INPUT OF SUPPORTING ACTIVITIES

5.1. Contribution of the Government of Japan

5.1.1. Assignment of Japanese experts

Seven long-term experts in five fields specified in the R/D were dispatched. In addition, 25 short-term experts in ten fields were sent when the necessity arose. Short-term experts play vital roles in backing up long-term experts and covering the research activities.

Two of short-term experts were dispatched for the preparatory study before the R/D was signed. One more long-term and four more short-term experts are planned to be dispatched by December 14, 1991.

The dispatch of experts was made almost on schedule, but that of the expert in the field of microbiology was delayed, and the expert was absent for one year (see Appendix 2).

5.1.2. Provision of machinery and equipment

Various laboratory apparatus for the Project were provided by Japan, amounting to approximately 192 million yen.

Equipment and other materials generally met the needs of the Project, and most of them have been well maintained and used effectively. A sufficient budget should be set aside for maintenance of the equipment (see Appendix 3).

5.1.3. Training of Thai counterparts in Japan

Thirteen Thai counterparts received training in Japan.Three more are planned to be sent by December 14, 1991.

Of the 13 counterparts, nine were trained by JICA at several national agricultural research institutes, and four participated in study tours. All the ex-trainees are still involved in the Project (see Appendix 4).

As a result of a training, one counterpart in Microbe section will acquire a doctoral degree from a university in Japan.

5.1.4. Others

(1) JICA took the following special measures to supplement the local costs, amounting to 37 million yen.

Firstly, a fund amounting to 23 million yen was allocated to the Project for repairing the water reservoir at the Station in 1987, and for modifying the laboratory at the Station in 1988. In addition, the roof of an annex building was expanded for smooth operation in the rainy season, and a storehouse in Post-harvest section was built in 1989 at Klong Luang.

Secondly, a fund amounting to 3.2 million yen was extended to supply sample maize and to build a storehouse for experiments. The storehouse will be built at the Station in 1991.

Thirdly, a fund of 2.9 million yen was extended for the survey of maize production and marketing in order to obtain basic data. The survey is being led by a professor from Kasetsert University.

Fourthly, a fund of 8 million yen was provided for operational costs.

Since it comes in the fifth year of the cooperation period, the Project should prepare manuals on practical countermeasures for aflatoxin contamination and provide a final seminar for making full use of Project benefits.

(2) Seven JICA missions were dispatched for the Project to give technical guidance, to review, discuss technical issues and so forth (see Appendix 5).

5.2. Measures taken by the Government of Thailand

5.2.1. Provision of land, buildings and facilities

Land, buildings and facilities necessary for the Project were provided by DOA.

The Maize Quality Improvement Research Center was constructed in March, 1988 under the general grant aid program by the Government of Japan amounting to 680 million yen. Since then, activities of the Project have started in full force.

5.2.2. Assignment of counterparts and other personnel

Personnel have been assigned to the Project since 1988. The number of staff personnel amounts to 68 in 1991, comprising 32 permanent and 36 temporary staffs.

All the permanent staff members are counterparts of the Project. 24 of them are technical personnel, while the remaining 8 are administrative personnel (see Appendix 6).

5.2.3. Counterpart budget allocation

The Government of Thailand provided funds for temporary wages, operational costs, public utility costs, and civil works & equipment costs. The total amount allocated to the Project since 1987 is about 18 million baht. Operational costs cover travelling, lodging, consumatives, spareparts and so forth. Microbe section spent a half of the expenses (see Appendix 7).

6. RESEARCH HIGHLIGHT

6.1. Agronomy

(1) Impact of cultural practices on aflatoxin contamination

In order to clarify the background of aflatoxin problem in Thai maize production, major cultural practices such as variety selection, planting date, harvesting date, irrigation, plant density, nitrogen application, crop rotation and insect control have been intensively investigated in relation to aflatoxin contamination. Aflatoxin contamination tended to be reduced by harvesting at well ripen stage. Aflatoxin contamination, however, was scarcely found at harvest regardless of the above cultural practices and appeared only during storage period. Aflatoxin contamination was found to be increased mainly by high moisture contents of kernel and high relative humidity both at and after harvest time.

(2) Development of new harvest method to prevent aflatoxin contamination

Harvesting with husk prevented maize kernel from aflatoxin contamination during storage period as compared with an usual harvesting with husk removal. Kernel moisture contents during storage period were not significantly different in both methods. By harvesting with husk, however, contamination level of aflatoxin was reduced in an average by 84.0%, 88.6% and 60.5% when maize was harvested at 95, 105 and 115 days after planting, respectively. In case of usual harvest safety storage periods, during which aflatoxin contamination is kept under 20ppb, were 1.3, 2.7 and 3.3 weeks when harvested at 95, 105 and 115 days after planting, respectively. But the new harvest method prolonged the safety storage periods to 4.7, 5.3 and 6.7 weeks for the same days of harvest after planting.

On-farm trials of this new harvest method was started in 1990. The two harvest methods were compared under the storage conditions of three farms at different locations for eight weeks. Average aflatoxin contaminations in harvest without husk in Farm 1, Farm 2 and Farm 3 were 179.9, 294.3 and 273.3 ppb, respectively. The new method reduced the same to 66.5, 103.2 and 119.9 ppb,

respectively. Although contamination level was practically higher than the safety level, the new harvest method decreased the aflatoxin contamination by 63.0% at Farm 1, 64.9% at Farm 2 and 56.1% at farm 3. Visual quality of kernel, however, was affected by fungus, Botryodiplodia spp. which might attach to the kernels in the field and to be infected by high temperature and high humidity during storage. Botryodiplodia infection changed the color of kernel pericarp to blacklish and endosperms to greenish.

Based on the above results, the new harvest method may be recommended as a technic at farmer's level to prevent aflatoxin contamination of maize kernel under Thai socio-economical condition, providing the problem of Botryodiplodia infection is solved by future research.

(3) Analysis of ecology of A. flavus

To obtain the basic information on aflatoxin problem, A. flavus in air during the maize growing period was observed in the field, shelling places and storage places. Frequency of air samples (0.09 cubic meter) with A. flavus was changed more by weather conditions than by season or year. For example, the percentages of air samples with A. flavus were 15.8 in clear-sky day, 5.3 in cloudy day and 0.0 in rainy day in 1989. In addition, A. flavus in air samples was observed more frequently both in shelling places and storage places than in the field.

An attempt has been made to monitor aflatoxin occurrence in the major maize production areas. But the consistent results were not obtained because of variation in storage conditions and storage periods in different places.

These research findings will give us some basic information to uncover the infection route of A. flavus. Therefore, it is preferable to continue the research until the complete data will be accumulated.

(4) Development of simulation model of maize productivity and its quality

To study systematically the Thai maize production and its quality, establishment of simulation model has been attempted. This study proceeded under short-term cooperative training by Japanese experts for model building and measurement of physiological parameters. Japanese model for whole crop production of maize was modified and adopted for grain production in Thailand. Because of the fluctuation in precipitation in Thailand, in addition to temperature and solar energy precipitation was also necessary to be used in the Thai version of the Japanese model. To develop the complete model, additional research will be required especially regarding maize quality.

6.2. Post harvest

(1) Investigation of aflatoxin contamination factors in Thai maize

Field survey on farmers and middlemen revealed that aflatoxin contamination was detected mainly from 1st crop of maize in the two cropping area and in the mono-cropping area, and that nearly half of samples were infected by A. flavus within 10 days after harvesting time.

Aflatoxin contamination of shelled maize occurred within two weeks over 17% of moisture content, with the peak of the contamination at 22% of moisture content. Furthermore, damage and impurity of maize kernel accelerated aflatoxin contamination.

High moisture ear maize was also easily contaminated if stored under humid condition. A. flavus infection was induced even by small damage of kernel.

(2) Improvement of moisture meter for ear maize

It was essential to measure moisture content of maize for determination of harvest time and post-harvest procedure. So, moisture meter was necessary to be developed with low price especially at

farmers' level. To save fabrication cost, a sensor of moisture meter of rice was modified. This modified sensor consisted of two metal screws and a bar to press ear maize. Then new meter was calibrated with oven method.

This new meter had about 2% of standard error at measurement and may be used practically to measure moisture content of ear maize.

(3) Improvement of corn sheller for high moisture maize

Mechanical damage was an important factor of aflatoxin contamination, and shelling process was one of the major sources of it. So it was necessary to improve corn sheller with less breakage of maize kernel.

Three types of cylinders (rectangular spike tooth cylinder with drum, spike tooth cylinder with drum, and spike tooth cylinder with cage) were selected from the results of performance tests of established corn sheller and trial cylinders. These three models were equivalent in shelling efficiency, because they showed no significant difference at cylinder peripheral speed of 10 to 12.5 m/s. While the experiments had been conducted for three years, the ratio of kernel breakage had been reduced from year to year. This year ly trend suggested that precision of fabrication closely relate to shelling efficiency.

To assemble a newly improved corn sheller, spike tooth cylinder with cage was selected with special reference to simplification of fabrication and maintenance of sheller. Further study on adjustment of operational condition (air flow rate, sieving speed, etc.) will be necessary to assemble new corn sheller, of which cleaning parts has been already developed in Thailand.

On the other hand, another experiment of corn sheller for ear maize with husk was conducted, based on the suggestion by Agronomy section that harvesting and storing with husk reduced aflatoxin contamination. A sheller with rasp-bar cylinder showed good shelling efficiency for ear maize with husk. This sheller may be adopted practically if harvesting with husk is put to practical

use at farmers' level.

(4) Improvement of farmers' storage for ear maize

This experiment was conducted to clarify the inner condition of farmers' storage and to modify it for preventing aflatoxin contamination. Two farm scale cribs were fabricated. One was modified with three air ducts, one of which was set at the bottom and two of which were set in the middle layer. Five tons of ear maize were stored in each crib and changes in temperature were observed. Aflatoxin contamination and moisture content were analyzed 3, 7, 14, 30 and 63 days after the beginning of storage period. High temperature zone was observed in the central part of each crib. Temperature rise was reduced by three air ducts, especially the one at the bottom had the largest effect for temperature reduction. Drying of ear maize was faster in the modified crib than in control crib. Aflatoxin contamination in both cribs initiated three days after the beginning of storage and reached over 10 ppb of safety level seven days after the beginning of storage.

Further study on modification of cribs and development of drying method for ear maize in cribs will be necessary to reduce aflatoxin contamination in farmers' storage.

6.3. Microbe

Microbe section has close relation with researches of Agronomy and Post-harvest sections. Some subjects in this Project were studied as the joint research works by Microbe and the other sections. In the joint works, Microbe section conducted mainly microbiological study and aflatoxin analysis for Agronomy and Post-harvest sections.

Microbe section also carried out its own subjects.

(1) Investigation of aflatoxin contamination and A. flavus infection in maize

To know the actual situation of aflatoxin contamination

and A. flavus infection route in Thai maize. Various samples, such as air and soil in maize fields, were collected in north and central maize production areas for microbiological study and aflatoxin analysis. The high population of A. flavus was observed in the soil samples of the fields and both of farmer and middleman warehouses. Freshly harvested ear maize and shelled maize kernel were cleaner than long term stored maize kernel. The number of A. flavus in air was very high near by working shelling machine, but normally very low in maize field. The shelling process is presumed as a main infection route by A. flavus. Although wide variations in aflatoxin contamination of maize were observed, shelled maize kernel was usually highly contaminated by aflatoxin as compared with ear maize. It seemed to be no regional difference in A. flavus infection and aflatoxin contamination.

(2) Equilibrium moisture content of maize kernel and growth of A. flavus

Moisture content in maize kernel was largely influenced by surrounding atmosphere during drying or storing. Basic data of absorb and release water in maize kernel must be useful for studying the process of drying or storing. Under high humidity condition, 93 and 84% relative humidity (RH), moisture content of maize kernel equilibrated to 20-21 and 16-17% respectively, and mold grew on the surface of maize kernel within 8 weeks. Under condition below 80, 75 and 70% RH, moisture content of maize kernel equilibrated to 15-16, 14-15 and 13-14% respectively after 9 weeks, and no mold was observed.

(3) Development of simple and rapid analytical method of aflatoxin

Bright greenish yellow fluorescence method (BGYF), immunoassay method (ELISA) and mini-column method were examined for development of simple and rapid analytical method of aflatoxin. There were some accurate analytical method for aflatoxin using Hi-tech instruments, such as HPLC and TLC, but they were expensive, time consuming, and also required skilled technicians.

BGYF was simple and rapid analytical method, but not satisfactory in accuracy.

ELISA was recognized to be a rapid analytical method with high sensitivity. However, skilled persons and some special equipment were required, and also the kit was expensive.

The principle of mini-column method was the column chromatography using several absorbent and dehydrating agent. In order to save the chemicals, glasses and consuming time, the new simplified mini-column method was developed for the inspection of aflatoxin in maize. The new method needed only 4 chemicals while the conventional methods needed 12-15 chemicals. The consumning time was only 15 minutes. Cost per unit was reduced from 50 Baht to 18 Baht. The detection efficiency was as low as 10 ppb. The new method could be easily transferred and handled by unexperienced people. Therefore, this method can be extensively utilized in the field for aflatoxin inspection.

(4) Prevention of aflatoxin contamination of maize kernel by using plastic bag

Tropical Agriculture Research Center, MAFF, Japan (TARC) and Microbe Section have found the fact that anaerobic condition in high density polyethylene bag had an effect to prevent growth of A. flavus, specially of high moisture maize kernel. When high moisture maize kernel were kept under anaerobic condition using the plastic bag, the growth of A. flavus and other mold on the maize kernel could be inhibited within 4 weeks. Moreover, maize kernels that were kept in the bag for 1-4 weeks could be utilized as feed to broilers without any harmful effect.

7. IMPACTS OF THE PROJECT

The project comprises four sections, namely Administration, Agronomy, Post-harvest and Microbe. Each section has worked closely and obtained the results which appeal to the respective beneficiaries.

Agronomy section carried out 13 research items and the technology will be transferred to farmers through extension channel. Post-harvest section conducted 17 research items and the results are expected to be utilized by farmers and middlemen. Microbe section conducted 13 research items and obtained the basic results which develop into applied research.

The results of the Project were presented at the Annual Conference of DOA and the workshops held occasionally. Experts and counterparts of the Project participated in the training course on micotoxin prevention and control, which was held by DOA for Thai researchers in 1988 and 1989. These activities contributed to raising the morale on the necessity of aflatoxin contamination control.

At present, the survey on maize commodity system is ongoing. The results of the survey will contribute to providing a guidline for planning future Thai maize policy.

Information on aflatoxin control is being collected and put into the computers provided by JICA. The information service will be utilized nationwide.

8. MANAGEMENT OF THE PROJECT

A joint committee meeting was held once every year with the study teams dispatched since 1988. The committee reviewed the overall progress of the Project and exchanged views

on major issues, and its decision was substantially reflected in the activities of the Project.

Besides, two other committees and four working groups were organized for smooth management of the Project. A coordinating committee meeting has been held seven times so far, while a coordinating sub-committee has met twelve times. The working group meetings were held by the respective sections when necessary.

Each section of the project belongs to an independent division under the Department of Agriculture and two of them have their bases away from the Center in Bangkhen. Agronomy section, which belongs to the Field Crops Research Institute, is located at Phra Phutthabat, 130 kilometers from the Center, and Post-harvest section is separated from Agricultural Engineering Division in Klong Luang at a distance of 35 kilometers. Close contact should be kept among the sections of the Project for sustaining research activities (see Appendix 8).

9. CONCLUSION AND RECOMMENDATION

After the beginning of the project in December 1986, the Project has made a number of achievements and has improved the capability of Thai counterparts in planning and conducting research works as seen in the above sections. Considering that the Project has newly tackled the problem of aflatoxin contamination of maize in Thailand, these results should be esteemed highly.

On the other hand, the Project has substantially started in 1988 after completion of the Research Center and assignment of an expert in microbiology field. The research data for three years have been accumulated once every cropping season. Hence, the data in 1991 should be obtained and analyzed

to ensure further research.

In addition, the Project should produce technical manuals and a final seminar to disseminate the results obtained.

Six months will be required for the data analysis of 1991 cropping season and the manual-making. Furthermore, it must take another three months to prepare the seminar. Therefore, both teams recommend that the Project be extended for another nine months for data analysis, publishing manuals and holding a seminar.

In order to fully utilize the technology, equipment and facilities, it is recommended that DOA keep four sections working consistently and jointly even after the Project has been handed over to the Thai Government.

As for the future outlook, a study of simulation model is found of value as described in Research Highlights of Agronomy.

Appendix 1

PRODUCTION OF MAIZE IN THAILAND

Year	Planted Area (million hectare)	Product Amount (million ton)	Export Amount (million ton)	Export/Product ratio (%)
1970	0.68	1.70	1.45	85.3
1975	1.24	2.50	2.10	84.0
1980	1.52	2.86	2.20	76.9
1985	1.82	4.23	2.78	65.7
1986	1.98	4.93	4.01	81.3
1987	1.95	4.31	1.65	38.3
1988	1.75	2.78	1.21	43.5
1989	1.84	4.68	1.13	24.1

Source : Maize Quality Improvement Research Center

Appendix 2

LIST OF JAPANESE EXPERTS

(LONG - TERM EXPERTS)

NAME	FIELD	PERIOD
Mr. Takeji Seino	Coordinator	20 May.1987 - 14 Dec.1991
Mr. Makoto Kobayashi	Post-harvest	20 May.1987 - 19 Nov.1989
Mr. Teruhiko Nibe	Agronomy	30 Jun.1987 - 14 Dec.1991
Dr. Taketoshi Yoshiyama	Leader	21 Jul.1987 - 20 Dec.1989
Mr. Katsusuke Arai	Microbe	8 Jul.1988 - 14 Dec.1991
Mr. Seiichi Ueda	Leader	8 Dec.1989 - 30 Apr.1991
Mr. Mitsuhisa Harada	Post-harvest	8 Dec.1989 - 14 Dec.1991

(SHORT - TERM EXPERTS)

NAME	FIELD	PERIOD
Dr. Haruo Mikoshiba	Agronomy	17 Feb.1986 - 26 Feb.1986
Mr. Kazuaki Amari	Post-harvest	2 Mar.1986 - 15 Mar.1986
Mr. Yoshio Ideguchi	Civil Engineer	15 Dec.1987 - 26 Dec.1987
Mr. Shuichi Shimada	Microbe	11 Jan.1988 - 10 Mar.1988
Mr. Yuzuru Tomioka	Consultant	10 Mar.1988 - 8 Apr.1988
Mr. Yoshio Ideguchi	Civil Engineer	10 Mar.1988 - 17 Jun.1988
Mr. Yukio Azuma	Corn sheller	20 Jul.1988 - 19 Nov.1988
Mr. Mikio Kamo	Ammonia treatment	20 Jul.1988 - 19 Sep.1988
Mr. Nobuyoshi Ishitani	Moist. meter	1 Aug.1988 - 21 Aug.1988
Dr. Osamu Tsuruta	Microbe	19 Aug.1988 - 27 Sep.1988
Dr. Osamu Tsuruta	Microbe	16 Jun.1989 - 15 Aug.1989
Mr. Yukio Azuma	Corn sheller	6 Jul.1989 - 5 Nov.1989
Mr. Mikio Kamo	Ammonia treatment	6 Jul.1989 - 24 Aug.1989
Mr. Keiichi Inoue	Drying method	25 Jul.1989 - 24 Sep.1989
Mr. Nobuyoshi Ishitani	Moist. tester	1 Aug.1989 - 9 Sep.1989
Mr. Tetuhisa Goto	Aflatoxin analysis	14 Sep.1989 - 12 Dec.1989
Mr. Mikinori Tsuiki	Simulation	27 Sep.1989 - 26 Nov.1989
Dr. Toshitugu Tanaka	Aflatoxin analysis	4 Oct.1990 - 27 Nov.1990
Mr. Yukio Azuma	Corn sheller	20 Jul.1990 - 3 Nov.1990

Dr. Michihiko Saito	Microbe	20 Aug.1990 - 19 Oct.1990
Mr. Akira Matuzaki	Drying method	21 Aug.1990 - 19 Nov.1990
Mr. Yoshimitu Saito	Photosynthesis	6 Nov.1990 - 24 Dec.1990
Mr. Mikinori Tsuiki	Simulation	6 Nov.1990 - 16 Dec.1990
Dr. Michio Kozaki	Microbe	4 Dec.1990 - 17 Dec.1990
Dr. Osamu Saito	Entomology	3 Oct.1990 - 2 Dec.1990

Appendix 3 LIST OF EQUIPMENT PROVIDED BY JAPAN

Fiscal Year 1987	1988	1989	1990	1991
Amount 29 (million yen)	9	56	83	15 (estimate) total 192
(Main Equipment) Station wagon, Personal Computer, Temp. control box, Electronic balance, Dryer with timer, Rheometer, Maize sheller, Multi auto counter, etc.	Panel rack, Evaporation Sensor, Low temp. cubator, Clean bench, Convection oven, Temp. & hum. Transmitter, Monograin moist. tester, Precision dif. manometer, Color dif. mater, Multi hygrometer, Data logger, etc.	Word processor, Air Sampler, E.O.gas Sterilizer, Portable recorder, Personal computer, Recording tensionmeter, Corn sheller, Soft X-ray apparatus, Radiation converter, Electronic balance, Solar radiation sensor, Differential manometer, Cressida van, etc.	Portable Photo-synthesis, Main controller, Delta logger, Leaf area meter, Farm tractor, Lap-top computer, Forklift, Gas chromatograph, Personal system, Copy machine, Electrophoresis Set, etc.	Insect trap, Metheological apparatus, Tensionmeter, Electric back-up unit, Colony counter, Electrophoresis apparatus, Centrifugal separator, Auto-injector, Portable refrigerator, Torque meter, Load cell, Pressure meter, Data logger, etc.

Appendix 4 LIST OF THAI PERSONNEL TRAINED IN JAPAN

NAME	ASSIGNMENT	PERIOD
Ms. Sriwai Singhagajen	Scientific study tour	28 Sep.1987 - 17 Oct.1987
Mr. Narongsak Senanarong	Scientific study tour	28 Sep.1987 - 17 Oct.1987
Ms. Arunsri Wongurai	Aflatoxin analysis	16 May.1988 - 15 Sep.1988
Mr. Sukapong Vayuparp	Agronomy	20 Jun.1988 - 21 Oct.1988
Dr. Maitri Naewbanij	Post-harvest	2 Oct.1988 - 30 Nov.1988
Dr. Vijai Nopamornbodi	Scientific study tour	6 Mar.1989 - 24 Mar.1989
Mr. Prasop Debyasuvarn	Agronomy	10 Jul.1989 - 2 Sep.1989
Mr. Chaiwat Paosantadpanich	Post-harvest	30 Oct.1989 - 28 Jan.1990
Mr. Suparat Kositcharoenkul	Aflatoxin analysis	14 Jan.1990 - 17 Apr.1990
Ms. Siriporn Sindhusake	Scientific study tour	5 Mar.1990 - 28 Mar.1990
Ms. Kanjana Bhudhasamai	Microbiology	15 Oct.1990 - 20 Jan.1991

Ms. Prisnar Siriacha	Infection of Maize	30 Jun.1990 - 29 Jul.1990
Mr. Pimol Wutisin	Post-harvest	28 Jan.1991 - 28 Apr.1991

Appendix 5 PERFORMANCE OF MISSIONS DISPATCHED BY JICA

1. Contact Study Team for clarifying the background	21 Feb. 1985 - 26 Feb. 1985
2. Preparatory Study Team for making up Master Plan	1 Oct. 1985 - 10 Oct. 1985
3. Implementation Study for signning of Record of Discussion	8 Dec. 1986 - 17 Dec. 1986
4. Consultation Study for making up the 5-Year Plan in detail	28 Mar. 1988 - 8 Apr. 1988
5. Technical Guidance Team for discussing Progress and Future Plan of Research Activities	7 Mar. 1989 - 18 Mar. 1989
6. Technical Guidance Team for discussing Progress and Future Plan of Research Activities	9 Apr. 1990 - 21 Apr. 1990
7. Technical Guidance Team for discussing Progress and Pre-Evaluation of Research Activities	14 Jan. 1991 - 31 Jan. 1991

Appendix 6 CHANGE IN NUMBER OF THAI PERSONNEL OF THE PROJECT

No. of staff	Fiscal year 1986	1987	1988	1989	1990	1991
Permanent (Administrative)	-	-	8	8	8	8
Permanent (Technical)	-	-	21	22	24	24
Temporary staff	-	-	35	36	41 *	36
Total	-	-	64	66	73	68

* Two staffs are additionally assigned in support of Agricultural Engineering Division.

Appendix 7 BUDGET ALLOCATION BY THAI GOVERNMENT

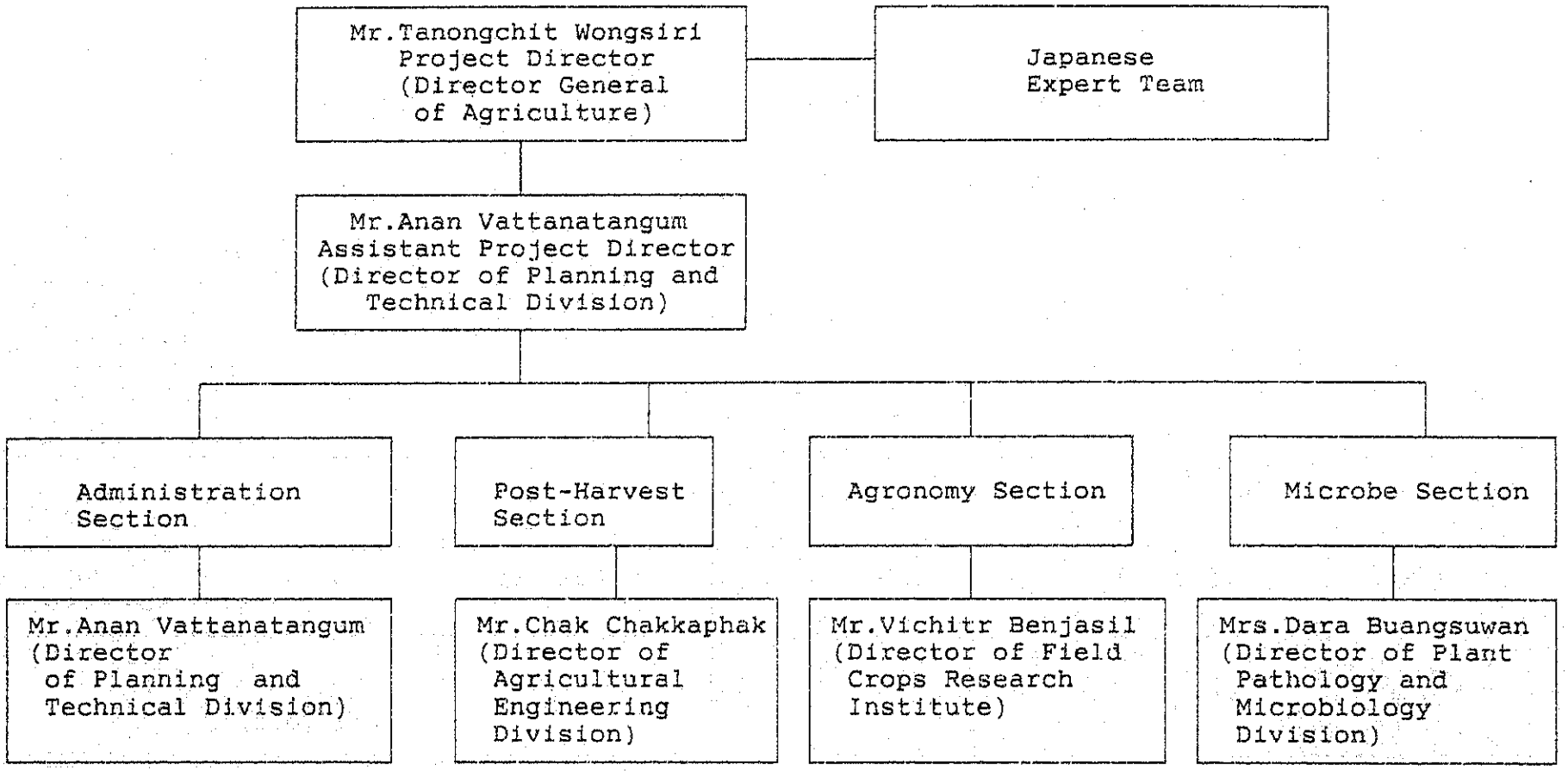
(unit: Baht)

	Fiscal Year 1987	1988	1989	1990	1991	Total
Temporary Wages	0	333,000	824,100	1,259,300	1,259,300	3,675,700
Operational Costs	0	979,100	1,872,200	2,865,200	3,283,900	9,000,400
Public Utility Costs	0	246,200	246,200	588,000	588,000	1,668,400
Civil Works & Equipment Costs	2,030,300	1,277,600	0	0	238,900	3,546,800
Total	2,030,300	2,835,900	2,942,500	4,712,500	5,370,100	17,891,300

*Remarks: Fiscal year for Thai Government starts in October.

Appendix 8

STRUCTURE OF THE PROJECT



② 英文質問票および回答

QUESTIONNAIRE ON

THE MAIZE QUALITY IMPROVEMENT RESEARCH CENTER PROJECT

IN THAILAND

1. Questions about the operating cost of the Project.

1.1 How has the budget been allocated for the Project by the Government of Thailand since 1986?

Fiscal year (October - September) (Unit : Baht)

	1986	1987	1988	1989	1990	1991	Total
Temperary Wages	-	-	333,000	824,100	1,259,300	1,259,300	3,675,700
Operational cost	-	-	979,100	1,872,200	2,865,200	3,283,900	9,000,400
Public utility cost	-	-	246,200	246,200	588,000	588,000	1,668,400
Civil work & equipment cost	-	2,030,300 *	1,277,600 *	-	-	238,900	3,546,800
Total budget	-	2,030,300	2,835,900	2,942,500	4,712,500	5,370,100	17,891,300

* Counterpart fund for Grant Aid Project

1.2 What are the main reasons why the budget has increased (or decreased)?
- The budget has increased because of national wage adjustment, maintenant cost, sampling analysis cost, and activities increased.

1.3 Do you think the budget allocation is sufficient for the activity?
- Hardly sufficient

Are there any items of the budget which must be increased for any particular reason?
- Maintenant cost for Equipments, Building facilities and Vehicles, etc

1.4 Is these any assistance for the Project from other countries or international organizations excluding Japan?
- None

2. Questions about the Project personnel.

2.1 How has the number of personnel for the Project changed since 1986?

Fiscal year						
No. of Staff	1986	1987	1988	1989	1990	1991
Permanent (Administrative)	-	-	8	8	8	8
Permanent (Technical)	-	-	21	22	24	24
Temperary staff	-	-	35	36	41 *	36
Total	-	-	64	66	73	68

* 2 Additional Temperary Staffs supported by the Agricultural Engineering Division

2.2 How has the number of counterparts of the Project changed since 1986?

No. of C/P	1986	1987	1988	1989	1990	1991
Administrative	-	-	8	8	8	8
Technical	-	-	21	22	24	24
Total	-	-	29	30	32	32

2.3 Please prepare the list of Thai personnel trained in Japan and note the present institutions and positions of ex-trainees.
- Refer to Document No. A

3. Questions about the achievement of each activity.

3.1 Please evaluatethe sustainability, viability and impact of each activity by classifying responses into three categories as shown in the table below :
- Refer to Document No.B.

3.2 What are main reasons why the activity achievement is ranked "A" (or "C")?
Criteria has been changed as follows by our convinience;

Achievement in %	Grade	Criteria
91 - 100%	A	*The study has been concluded and the result is ready to transfer technology.
81 - 90%	B	*Basic information was concluded. *The study has been concluded and the result is preparing for transfering the technology.
71 - 80%	C	*The study is proceeding for conclusion and need some additional data or information. *The study has been concluded, however the result of experiment was not practical yet.
61 - 70%	D	*The study is on-going at advanced stage.
< 60 %	E	*Newly raised subject or under the pre-experimental stage.

3.3 Do you have any requests for technical assistance for promoting the activities further?
- In relation to environmental conditions and aflatoxin incident, the simulation model of Thai maize is to be continued and the request has been submited.

4. Questions about the equipment and the facilities supplied through the Japanese technical cooperation.

- Refer to Document No. C.

4.1 Please evaluate the conditions of utilization and maintenance of the equipment supplied through Japanese cooperation by classifying your responses into three categories as shown in the table below :

Conditions of utilization	Conditions of maintenance
A. Used often	Always under best conditions
B. Used once in a while	Under fairly good conditions
C. Out of use	Out of order

4.2 What are the main reasons why the condition of the equipment is ranked "A" (or "C")?

- "C" mark is under seeking for the cause of trouble or under the adjustment of machine to obtain proper function.
- And also refer to the document No. C's remark.

4.3 Do you have any requests to repair or to supply spare parts for the equipment whose condition is ranked "C"?

- The request of spair parts and consumable items have been made in 1991 budget to JICA, however it is unlikely to be supplied due to the shortage of fund. The project is expecting to request again in 1992 budget when the project is extended.

4.4 Please prepare a list of equipment procured by the Thai side since 1986.

- Refer to Document No. D.

Fiscal year	Cost (Unit : Baht)	Name of facilities
1986	-	-
1987	-	-
1988	222,618	Office furniture *
1989	-	-
1990	-	-
1991	-	-

* Counterpart fund for the Grant Aid Project.

5. Questions about the plan to promote the Project more effectively.

5.1 Please prepare agricultural statistics related to maize for reference.
- Refer to Document No. E

5.2 Which activity do you think will receive the highest priority from now on?

Agronomy Section :
1. The first priority is to establish the new technology by harvesting and storing maize with husk.
2. The second priority is to develop simulation model of maize productivity, and its quality.
3. The third priority is to study tha effect of nitrogen regarding to prevention of aflatoxin contamination by the inoculation method.

Post-harvest Section :
1. Improvement of drying
2. Improvement of corn sheller
3. Improvement of farmer's storage

Microbe Section :
1. Aflatoxin prevention and control
2. Improvement of detection technics

5.3 What kind of requests do you have for future Japanese technical cooperation.
- One year Project extension (request has already been submitted)
- Simulation Model Program for Thai maize production (request has been already submitted)
- New Project Proposal of Mycotoxin Research is under consideration by the DOA.

Document No. A

List of Thai Personnel trained in Japan

Training in Japan	1st Year Dec.1986 ~ Dec. 1987	2nd Year Dec.1987 ~ Dec. 1988	3rd Year Dec.1988 ~ Dec. 1989	4th Year Dec.1989 ~ Dec. 1990	5th Year Dec.1990 ~ Dec. 1991
* 1987 Japanese Fiscal Year					
Mr. Narongsak Senanarong (Field Crops Research Institute)	■	(Sep.28 - Oct.17)			
Mrs. Srivai Singhagajen (Division of Agri. Engineering)	■	(Sep.28 - Oct.17)			
* 1988 Japanese Fiscal Year					
Ms. Arunsri Wongurai (Division of Plant Pathology and Microbiology)		■■■ (May 16 - Sep. 15)			
Mr. Sukapong Vayuparp (Field Crops Research Institute)		■■■ (Jun. 20 - Oct.21)			
Mr. Maitri Naewbanij (Division of Agri. Engineering)		■ (Oct.2 - Nov.30)			
Dr. Vijai Nopamornbodi (Administration)			■ (mar. 6 - Mar. 21)		
* 1989 Japanese Fiscal Year					
Mr. Suparat Kositchareonkul (Division of Plant Pathology and Microbiology)				■■(Jan. 14-Apr.17)	
Mr. Prasop Depayasuvan (Field Crops Research Institute)			■■(Jul.10-Sep.2)		
Mr. Chaiwat Paosantadpanich (Division of Ari. Engineering)				■■■(Oct.30-Jan.28)	
Mrs. Siriporn Sindhusake (Administration)				■(Mar.5-Mar.28)	
* 1990 Japanese Fiscal Year					
Mrs. Prisnar Siriacha (Division of Plant Pathology and Microbiology)					■(Jun.30-Jul.29,'90)
Mrs. Kanjana Bhudhsamai (Division of Plant Pathology and Microbiology)			(Oct.15,'90-Jan.15,'91) ■■		
Mr. Pimol Vitisin (Division of Ari. Engineering)				(Jan.28-Apr.28,'91)	■■

Document No. B

Research Implementation Plan

Items	Achievement and Evaluation	2nd Year Dec.1987-Dec.1988	3rd Year Dec.1988-Dec.1989	4th Year Dec.1989-Dec.1990	5th Year Dec.1990-Dec.199
1. Analysis of contamination factors					
1) Correlation between cultural practices and aflatoxin contamination (Agronomy)	70% D	———			
2) Correlation between post-harvest storing/processing and aflatoxin contamination (Post-harvest)	83% B	———			
3) Characteristics of Aspergillus flavus relating aflatoxin contamination (Agronomy and Microbe)	80% C	———			
2. Improvement of test technics					
1) Improvement of simple and rapid analytical method of aflatoxin (Microbe)	90% B	———			
2) Improvement of simple moisture meter (Post-harvest)	73% C	———			
3. Countermeasure of aflatoxin prevention					
1) Improvement of cultural practices (Agronomy)	80% C	———			
2) Improvement of post-harvest practices (Post-harvest)	77% C	———			
3) Aflatoxin prevention by controlling Aspergillus flavus (Microbe)	80% C	———			

( ) Conducting Experiment Section

Research Implementation Plan I - Agronomy

Items	1st Year Dec.1986- -Dec.1987	2nd Year Dec.1987- -Dec.1988	3rd Year Dec.1988- -Dec.1989	4th Year Dec.1989- -Dec.1990	5th Year Dec.1990- -Dec.1991
1. Analysis of contamination factors					
1) Correlation between cultural practices and aflatoxin contamination					
1.1 Varietal comparison of maize kernel moisture and its variation according to different times of harvesting		———	———	———	———
1.2 Long term study on the relationship of the environmental conditions that cause aflatoxin incidence in maize		———	———	———	———
1.3 Effects of different harvest methods, moisture conditions and storage periods on aflatoxin contamination in maize		———	———		
1.4 Effects of plant density and nitrogen application on aflatoxin contamination		———	———	———	
1.5 Effect of crop rotation on Aspergillus spp. in the soil		———	———	———	
1.6 Effect of nitrogen regarding prevention of aflatoxin contamination by the inoculation method			———	———	
1.7 Identification of maize insects and the types of damage they inflict on the maize kernel			———	———	———
1.8 Evaluation of insect damage that occurs under field conditions		———	———	———	
1.9 Relation between kernel type and resistance to fungus infection after inoculation					

Items	1st Year Dec.1986- -Dec.1987	2nd Year Dec.1987- -Dec.1988	3rd Year Dec.1988- -Dec.1989	4th Year Dec.1989- -Dec.1990	5th Year Dec.1990- -Dec.1991
1.10 Relation between environmental factors and fungus infection			———	———	———
1.11 Monitoring aflatoxin occurence in the major maize production areas			———		
1.12 Large scale practices on concerning harvest methods and aflatoxin occurence in maize				———	———
1.13 Basic agronomical study for developing the simulation model of maize productivity and its quality				———	———
1.14 Reduction on A.flavus infection and aflatoxin production by potassium application				———	———
1.15 Feasibility study of storage conditions for ear maize quality					———
1.16 Identification of insect as a vector of A.flavus under the field					———
3) Characteristics of Aspergillus flavus relating aflatoxin contamination					
3.5 Effect of crop rotation on Aspergillus spp. in the soil (1.5)		———	———	———	
3.10 Relation between environmental factors and fungus infection (1.10)			———	———	———
3.16 Identification of insect as a vector of A.flavus under the field (1.16)					———

Items	1st Year Dec.1986- -Dec.1987	2nd Year Dec.1987- -Dec.1988	3rd Year Dec.1988- -Dec.1989	4th Year Dec.1989- -Dec.1990	5th Year Dec.1990- -Dec.1991
3. Countermeasure of aflatoxin prevention					
1) Improvement of cultural practices					
1.3 Effect of different harvest methods, moisture conditions and storage periods on aflatoxin contamination in maize (1.3)				———	
1.6 Effect of nitrogen regarding prevention of aflatoxin contamination by the inoculation method (1.6)					———
1.12 Large scale practices on concerning harvest methods and aflatoxin occurence in maize (1.12)					———

Research Implementation Plan II - Post-harvest

Items	1st Year Dec.1986- -Dec.1987	2nd Year Dec.1987- -Dec.1988	3rd Year Dec.1988- -Dec.1989	4th Year Dec.1989- -Dec.1990	5th Year Dec.1990- -Dec.1991
1. Analysis of contamination factors					
2) Correlation between post-harvest storing/processing and aflatoxin contamination					
A. Survey on the present situation of farmers' and middle-men's post-harvest practices regarding maize in Thailand					
B. Correlation between machanical damage and aflatoxin contamination					
- Study on the relationship between damage on kernel, kernel moisture content and aflatoxin contamination					
- Estimate on increase of damaged kernel ratio during handling					
2. Improvement of test technics					
2) Improvement of simplified moisture meter					
- Standardization of the standard oven method					
- Calibration test of established moisture meter					
- Improvement and development of moisture meter					
3. Countermeasure of aflatoxin prevention during post-harvest process					
2) Improvement of post-harvest practices					
A. Study on the corn sheller improvement for high moisture maize					

Items	1st Year Dec.1986- -Dec.1987	2nd Year Dec.1987- -Dec.1988	3rd Year Dec.1988- -Dec.1989	4th Year Dec.1989- -Dec.1990	5th Year Dec.1990- -Dec.1991
- Performance test of established corn sheller for high moisture maize		———			
- Analysis of the relation between mechanical damage to kernel, machinery design, operational condition and moisture content of maize			———	———	
- Corn sheller improvement					———
B. Study on improvement of drying methods					
- Development of simple drying method					
- The solar energy and engine exhaust heat-supplemented ambient air drying method			———	———	
- Research on drying ear maize with vinyl plastic house (solar heat drying)					———
- Allowable duration for delay of drying in the post-harvest			———	———	———
C. Study on the chemical control of Aspergilius spp. in maize					
- Ammonia treatment of maize to control Aspergillus spp. and so prevent aflatoxin contamination		———	———	———	
- Urea treatment of maize to control Aspergillus spp. and so prevent aflatoxin contamination		———	———	———	
- Ammonia and sulfur dioxide supplemented ambient air drying of high moisture maize in Thailand			———	———	
- Sulfur dioxide supplemented storage of high moisture maize			———	———	———
D. Study on the improvement of storage facilities for farmers			———	———	———

Research Implementation Plan III - Microbe

Items	1st Year Dec.1986- -Dec.1987	2nd Year Dec.1987- -Dec.1988	3rd Year Dec.1988- -Dec.1989	4th Year Dec.1989- -Dec.1990	5th Year Dec.1990- -Dec.1991
1. Analysis of contamination factors					
1) Correlation between cultural practices and aflatoxin contamination					
1-1 Studies on the aflatoxin content of maize cultivated under different conditions		———	———	———	
2) Correlation between post-harvest storing/processing and aflatoxin contamination					
2-1 Studies on the aflatoxin content in maize shelled by different types of corn sheller under various operating conditions and moisture content of maize		———	———	———	
3) Characteristics of Aspergillus flavus relating aflatoxin contamination					
3-1 Studies on A.flavus and aflatoxin contamination routes in Thai maize			———	———	
3-2 Study on the population of A.flavus isolated from soil and air			———	———	
3-3 Water activity of maize and growth of A.flavus			———	———	
3-4 Equilibrium moisture content of maize and growth of A.flavus			———	———	

Items	1st Year Dec.1956- -Dec.1957	2nd Year Dec.1957- -Dec.1958	3rd Year Dec.1955- -Dec.1959	4th Year Dec.1959- -Dec.1990	5th Year Dec.1990- -Dec.1991
3-5 Studies on the population of A.flavus and aflatoxin content in ear maize stored with and without husk in farmer's crib					
3-6 A.flavus infection and contamination in the maize field					
3-7 Identification of aflatoxin producing ability of A.flavus by coconut powder and coconut cream agar					
3-8 Studies on A.flavus infection and aflatoxin contamination during sun dry in the middleman and laboratory scale					
3-9 Studies on the growth by A.flavus various strains from maize, air, and soil in maize field					
3-10 Changing of chemical property and aflatoxin formation in maize					
3-11 Changing of physical property and aflatoxin formation in maize					
3-12 Study on the contamination of A.flavus from insect damaged cob					

Items	1st Year Dec.1986- -Dec.1987	2nd Year Dec.1987- -Dec.1988	3rd Year Dec.1988- -Dec.1989	4th Year Dec.1989- -Dec.1990	5th Year Dec.1990- -Dec.1991
2. Improvement of test technics					
1) Improvement of simple and rapid analytical method of aflatoxin					
1-A&B Aflatoxin content in stored maize determined by Immunoassey (ELISA)					
1-C Improvement of the mini-column method for the aflatoxin content in maize					
3. Countermeasure of aflatoxin prevention					
3) Aflatoxin prevention by controlling A.flavus					
3-A Studies on the effect of ammonia treatment for prevention of fungus invasion on ear and grain maize					
3-B-1 Control of A.flavus and aflatoxin contamination of high moisture content of maize in anaerobic condition					
3-B-2 Effect of anaerobic condition to the growth of A. flavus					
3-B-3 Control of A.flavus and aflatoxin contamination of various moisture content of maize in anaerobic condition					
3-B-4 Population dynamic of microorganism involved in maize stored in anaerobic cohdition					

主要機材利用／保守管理状況

LIST OF EQUIPMENT FROM JICA (1987)

CLASS 1=>300,000B OR 1,600,000¥

CLASS 2=<1, >20,000B OR 100,000¥

Document No. C

NO	NAME	MODEL	CLASS	ONT.	CRY	PRICE	CAT.	SECTION	USE	MAIN	REMARKS
1	STATION WAGON	NISSAN BLUEBIRD	1	2	B	658,600.00	TCE	ADMI.	A	A	
2	OLYMPIA MASTERTYPE	BT	2	1	B	28,000.00	TCE	ADMI.	A	A	
3	AIRCONDITIONER	FRESH SCU 33	2	1	B	30,366.00	SSP	ADMI.	A	A	
4	CANON COPY MACHINE	NP-3525	2	1	B	170,500.00	TCE	ADMI.	A	A	
5	JAPANESE PRINTER	PC-PR201H2	2	1	¥	220,000.00	ACC	ADMI.	A	A	
6	ENGLISH WORDSTAR	SOFT	2	1	¥	115,000.00	ACC	ADMI.	A	A	
7	PERSONAL COMPUTER	NEC PE-9801 VM-21	2	1	¥	350,000.00	ACC	ADMI.	A	A	
8	U.POWER SYSTEM	UPS-062.2.72A	2	2	B	56,000.00	TCE	AGRO.	A	A	
9	TEMP.CONTROL BOX	NTL-500D	2	1	B	207,900.00	TCE	AGRO.	B	A	
10	REL.ILLUMIN.METER	NS-2	2	1	B	38,420.00	TCE	AGRO.	A	B	
11	PAPER COPIER	FC-5	2	1	B	36,500.00	TCE	AGRO.	A	C	更新の必要あり
12	TEMPERATURE RECORDER	EL100-06	2	1	B	68,000.00	TCE	AGRO.	A	A	
13	E/T ELEC.TYPEWRITER	STANDARD 200 BT	2	1	B	28,900.00	TCE	AGRO.	A	B	
14	ELECTRONIC BALANCE	FX-300	2	5	B	275,000.00	TCE	AGRO.	B	A	
15	CHLOROPHYL METER	SPAD-501	2	1	B	40,680.00	TCE	AGRO.	A	A	
16	THERMOMETER		2	1	B	20,500.00	TCE	AGRO.	B	A	
17	DRYER WITH TIMER	SHIMIZU PS-712	2	1	B	259,000.00	TCE	AGRO.	A	A	
18	ANEMOMETER	SHIBATA	2	2	B	80,000.00	TCE	AGRO.	A	A	
19	RHEOMETER	FUDOH KOGYO	1	1	B	435,000.00	TCE	MICRO	B	A	
20	AUTO VOL.REGULATOR	7.5KVA, 27.27A	2	2	B	86,600.00	TCE	MICRO	A	A	
21	VACUUM EVAPORATOR	N-4, A-3S	2	1	B	84,000.00	TCE	MICRO	A	A	
22	CHROMATO VUE CABINET	FUNAKOSHI YAKUHIN	2	1	B	61,600.00	TCE	MICRO	A	A	

主要機材利用／保守管理状況　　CLASS 1=>300,000B OR 1,600,000¥

LIST OF EQUIPMENT FROM JICA (1987)　　CLASS 2=<1, >20,000B OR 100,000¥

NO	N A M E	M O D E L	CLASS	QNT.	CRY	P R I C E	CAT.	SECTION	USE	MAIN	R E M A R K S
23	MAIZE SHELLER	MS-800	1	1	B	1,280,000.00	TCE	P.HAR	B	A	
24	BATTERY QUICK CHARGE	EM-700	2	1	B	31,750.00	TCE	P.HAR	A	A	
25	DRYING OVEN	PS-760	2	1	B	79,000.00	TCE	P.HAR	C	C	故障につき現在修理申請中
26	MOISTURE TESTER	CTR-800	2	1	B	99,000.00	TCE	P.HAR	A	B	
27	MOTOR PULLER SET	E-24	2	1	B	26,450.00	TCE	P.HAR	A	A	
28	MULTI AUTO COUNTER	KIYA KC-1	2	1	B	279,400.00	TCE	P.HAR	B	A	
29	MOISTURE TESTER	SMR-40	2	1	B	105,000.00	TCE	P.HAR	A	A	
30	CAR WASHER	CWH-780	2	1	B	135,600.00	TCE	P.HAR	A	A	
31	AIRCOMPRESSER	SP-15CP	2	1	B	65,000.00	TCE	P.HAR	A	A	
32	MOISTURE METER	KOMETTO C-D2L	2	3	¥	144,000.00	ACC	P.HAR	A	A	

主要機材利用／保守管理状況

LIST OF EQUIPMENT FROM JICA (1988)

CLASS 1=>300,000B OR 1,600,000¥

CLASS 2=<1,> 20,000B OR 100,000¥

NO	NAME	MODEL	CLASS	QNT.	CRY	PRICE	CAT.	SECTION	USE	MAIN	REMARKS
1	SUZUKI MOTORCYCLES	RC100SSJ	2	3	B	85,500.00	TCE	AGRO.	A	A	
2	CROSS BEATER MILL	TYPE SK 1	2	1	B	67,500.00	TCE	AGRO.	A	A	
3	KUBOTA POWER SPRAYER	KS-43E	2	2	B	23,000.00	TCE	AGRO.	A	A	
4	AIRCONDITION	25000 BTU	2	1	B	30,000.00	SSP	AGRO.	A	A	
5	COOLING ACE & ASPIRATOR	CA-111A	2	1	B	75,600.00	TCE	AGRO.	A	A	
6	CYCLONE,RECEPTACH 5 1	RETSH(PARTS)	2	1	B	25,200.00	TCE	AGRO.	B	A	
7	LOW TEMP FREEZER	ULT 1535	2	1	B	75,800.00	TCE	AGRO.	B	A	
8	VIBRATONY FEID JOR	RETSH(PARTS)	2	1	B	33,500.00	TCE	AGRO.	A	A	
9	KUBOTA POWER TILLER	K120 X GA100	2	1	B	140,000.00	TCE	AGRO.	A	A	
10	SUCTION PUMP	FS2J 518 80X65	2	1	B	31,600.00	TCE	AGRO.	A	A	
11	SUBMERSIBLE PUMP	SP27-7	2	1	B	91,350.00	TCE	AGRO.	A	A	
12	CROSS BEATER MILL	TYPE SK FOR 220VOLTS	2	1	B	67,500.00	TCE	AGRO.	A	A	
13	STAINLESS STEEL 24 TEETH	RETSCH (PARTS)	2	1	B	27,000.00	TCE	AGRO.	A	A	
14	ROTARY VACUUM EVAPORATOR	MODEL N-1	2	1	B	31,290.00	TCE	AGRO.	A	A	
15	COMPUTER	SUPER/AT/TURBO	2	1	B	138,800.00	TCE	AGRO.	A	A	
16	SELF BALANCING RECORDER	M-187	2	1	¥	486,000.00	TCE	AGRO.	A	A	
17	PANEL RACK	M-351-18	2	1	¥	1,140,000.00	TCE	AGRO.	A	A	
18	INSTRUMENT SHELTER	M-011-02	2	1	¥	193,000.00	TCE	AGRO.	A	A	
19	ROTARY VACUUM EVAPORATOR	MODEL N-1	2	1	¥	149,000.00	TCE	AGRO.	A	A	
20	SHAKER	SA-31 AC220V 50HZ	2	1	¥	227,000.00	TCE	AGRO.	A	A	

主要機材利用／保守管理状況　　CLASS 1=>300,000B OR 1,600,000¥

LIST OF EQUIPMENT FROM JICA (1988)　　CLASS 2=<1,> 20,000B OR 100,000¥

NO	N A M E	M O D E L	CLASS	QNT.	CRY	P R I C E	CAT.	SECTION	USE	MAIN	R E M A R K S
21	EVAPORATION SENSOR	D-211	2	1	¥	594,000.00	TCE	AGRO.	C	A	現在、調整中
22	TERMINAL BOARD	M-452-10	2	1	¥	103,000.00	TCE	AGRO.	C	A	〃
23	RAINFALL CONVERTOR	M-824	2	1	¥	194,000.00	TCE	AGRO.	C	A	〃
24	RAINFALL SENSOR	B-011-00	2	1	¥	102,000.00	TCE	AGRO.	C	A	〃
25	POWER MODULE	M-831	2	1	¥	225,000.00	TCE	AGRO.	C	A	〃
26	SOLAR RADIATION CONVERTOR	M-825	2	1	¥	307,000.00	TCE	AGRO.	C	A	〃
27	DEWPOINT SENSOR	E-771-11	2	1	¥	123,000.00	TCE	AGRO.	C	A	〃
28	TEMP&HUM. CONVERTOR	M-824	2	1	¥	307,000.00	TCE	AGRO.	C	A	〃
29	POWER SUPPLY STABILIZER	NSP-1KVA	2	1	¥	490,000.00	TCE	AGRO.	C	A	〃
30	LOW TEMP. CUBATOR	EL-5R3 220V	1	1	¥	2,667,000.00	TCE	MICRO	A	A	
31	DEHUMIDIFIER	11.8L, W25Q	2	2	B	52,800.00	TCE	MICRO	A	A	
32	DEHUMIDIFIER	11.8L, W25Q	2	1	B	26,400.00	SSP	MICRO	A	A	
33	DRYING STERILIZER	SG-62 WITH TIMER	2	1	¥	301,000.00	TCE	MICRO	A	A	
34	CLEAN BENCH	CCV-811	2	1	¥	1,127,000.00	TCE	MICRO	A	A	
35	OBJECTIVE LENS	NIKON 60X	2	1	¥	141,000.00	TCE	MICRO	A	A	
36	CONVECTION OVEN	DN-63	2	1	¥	355,000.00	TCE	MICRO	A	A	
37	CONVECTION OVEN	DN-93	2	1	¥	995,000.00	TCE	MICRO	A	A	
38	ANALOG TO DIGI CONVERTER		2	1	B	24,848.00	TCE	P.HAR	B	A	
39	TRANSDUCER EXCITATION		2	1	B	20,160.00	TCE	P.HAR	A	A	
40	PLOTTER WITH CABLE	DXY 1300	2	1	B	46,500.00	TCE	P.HAR	A	A	

主要機材利用／保守管理状況　　CLASS 1=>300,000B OR 1,600,000¥

LIST OF EQUIPMENT FROM JICA (1988)　　CLASS 2=<1,> 20,000B OR 100,000¥

NO	NAME	MODEL	CLASS	QNT.	CRY	PRICE	CAT.	SECTION	USE	MAIN	REMARKS
41	MAIZE BELT CONVEYER		2	1	B	37,000.00	TCE	P.HAR	A	A	
42	GRAPHIC DIGITIZER	KD 4300 B & CABLE	2	1	B	23,000.00	TCE	P.HAR	A	A	
43	COUNTER TOTALIZER		2	1	B	27,972.00	TCE	P.HAR	B	A	
44	DATA LOGGER MAINFRAME	& PRINTER S/N 474500	2	1	B	232,848.00	TCE	P.HAR	A	A	
45	V.S. MOTOR & ACCESSORY	MOTOR 15 HP	2	1	B	52,000.00	TCE	P.HAR	A	A	
46	V.S. MOTOR & ACCESSORY	MOTOR 10 HP	2	1	B	38,160.00	TCE	P.HAR	A	A	
47	THERMOCOUPLE OR DC VOLT		2	3	B	60,480.00	TCE	P.HAR	B	A	
48	ADVANCED MATH OPTION		2	1	B	37,296.00	TCE	P.HAR	A	A	
49	CATRIDGE TAPE DRIVE	DC 100	2	1	B	58,968.00	TCE	P.HAR	B	A	
50	RS 232INTERFACE		2	1	B	30,744.00	TCE	P.HAR	A	A	
51	NEC POWER MATE		2	2	B	114,800.00	TCE	P.HAR	A	A	
52	PRINTER	EPSON LQ1050 & CABLE	2	2	B	47,000.00	TCE	P.HAR	A	A	
53	CORN SHELLER		2	1	B	25,500.00	TCE	P.HAR	A	A	
54	HARDNESS TESTER	KIYA 1600-D	2	1	¥	107,000.00	TCE	P.HAR	B	A	
55	MOISTURE METER	CTR-800	2	1	¥	433,000.00	ACC	P.HAR	B	B	(MR. ISHITANI)
56	TEMP&HUM. TRANSMITTER	THT-A	2	5	¥	640,000.00	TCE	P.HAR	B	B	
57	MONOGRAIN MOISTURE TESTER	CRT-160A	2	1	¥	525,000.00	TCE	P.HAR	A	B	
58	MOISTURE METER	SMR-40	2	1	¥	438,000.00	ACC	P.HAR	A	A	(MR. ISHITANI)

主要機材利用／保守管理状況　　CLASS 1=>300,000B OR 1,500,000¥

LIST OF EQUIPMENT FROM JICA (1988)　　CLASS 2=<1,> 20,000B OR 100,000¥

NO	NAME	MODEL	CLASS	QNT.	CRY	PRICE	CAT.	SECTION	USE	MAIN	REMARKS
59	SOFTWARE,DATA TRANSFER	FOR RC98, BASIC	2	1	¥	369,000.00	TCE	P.HAR	A	A	
60	PRECISION DIF. MANOMETER	ISP-3-50Ds 220V	2	1	¥	923,000.00	TCE	P.HAR	B	A	
61	DIGITAL PRINTER	TYPE:3171	2	1	¥	153,000.00	TCE	P.HAR	A	A	
62	DATA MEMORY	MP100FD WRITER	2	1	¥	406,000.00	TCE	P.HAR	B	A	
63	POWER METER	CLAMP:3 PHASE, 3161	2	1	¥	185,000.00	TCE	P.HAR	A	A	
64	GP-IB CONVERTOR		2	1	¥	176,000.00	TCE	P.HAR	A	A	
65	GP-IB INTERFACE ADAPTER	TYPE:3172	2	1	¥	133,000.00	TCE	P.HAR	A	A	
66	DATA MEMORY	S-RAM	2	1	¥	191,000.00	TCE	P.HAR	B	B	
67	BOTTLE RACK	U-153GW	2	1	¥	128,700.00	TCE	P.HAR	A	A	
68	COLOR DIFFERENCE METER	TC-PIII	2	1	¥	840,000.00	TCE	P.HAR	B	A	
69	THERMOCOUPLE TRANSMITTER	TCS-25B AC100V	2	2	¥	242,000.00	TCE	P.HAR	B	A	
70	PLOTTER FOR PC98	PL-500	2	1	¥	164,000.00	TCE	P.HAR	B	B	
71	MULTI HYGROMETER	SM370 220V	2	2	¥	852,000.00	TCE	P.HAR	B	B	
72	DATA LOGGER	TYPE:5001A	2	1	¥	612,000.00	TCE	P.HAR	A	A	
73	THERMOCOUPLE MODULE	AD-12-16(98)	2	1	¥	148,000.00	TCE	P.HAR	B	A	

主要機材利用／保守管理状況

LIST OF EQUIPMENT FROM JICA (1989)

CLASS 1=>300,000B OR 1,600,000¥

CLASS 2=<1, >20,000B OR 100,000¥

NO	NAME	MODEL	CLASS	QNT.	CRY	PRICE	CAT.	SECTION	USE	MAIN	REMARKS
1	WORD PROCESSOR	CANOWORD4100	2	1	¥	237,000.00	ACC	ADMI.	A	A	
2	AIR SAMPLER	SAS COMPACT	2	1	¥	560,000.00	ACC	MICRO.	A	A	
3	E.O. GAS STERILIZER	SEMMEL-502 220V	2	1	¥	322,800.00	ACC	MICRO.	B	A	
4	PORTABLE RECORDER	MODEL 3057-23	2	1	¥	225,000.00	ACC	P.HAR	A	A	
5	OXYGEN METER	OX61 YOKOGAW E	2	1	¥	186,240.00	ACC	P.HAR	B	A	
6	PERSONAL COMPUTER	PC-286 LE std	2	1	¥	257,600.00	ACC	P.HAR	A	B	
7	A/D BOARD	MODEL 12 A/D -L	2	1	¥	168,300.00	ACC	P.HAR	B	A	
8	GAS DETECTOR	GASTEC 801	2	1	¥	135,000.00	ACC	P.HAR	A	A	
1	RECORDING TENSIONMETER	DAIKI DIK-3202	2	2	¥	346,000.00	TCE	AGRO.	A	A	
2	CORN SHELLER	TIKUMASUKI 3	2	1	¥	360,000.00	TCE	MICRO	A	A	
3	SOFT X-RAY APPARATUS	SOFROM SRO-505	1	1	¥	2,346,000.00	TCE	P.HAR	B	A	
4	RADIATION CONVERTER	NAKAASA M-825	2	1	¥	314,000.00	TCE	P.HAR	B	A	
5	ELECTRONIC BALANCE	TERAOKA S-NK300	2	2	¥	210,000.00	TCE	P.HAR	A	A	
6	SOLAR RADIATION SENSOR	NAKAASA H-201	2	2	¥	538,000.00	TCE	P.HAR	B	A	
7	DIFFERENTIAL MANOMETER	SHIBATA ISP-6-50D	2	1	¥	693,000.00	TCE	P.HAR	B	A	
8	DIFFERENTIAL MANOMETER	SHIBATA ISP-6-2000D	2	1	¥	693,000.00	TCE	P.HAR	B	A	

主要機材利用／保守管理状況

LIST OF EQUIPMENT FROM JICA (1989)

CLASS 1=>300,000B OR 1,600,000¥

CLASS 2=<1, >20,000B OR 100,000¥

NO	NAME	MODEL	CLASS	QNT.	CRY	PRICE	CAT.	SECTION	USE	MAIN	REMARKS
9	TOYOTA CRESSIDA VAN	1990	1	1	B	355,000.00	TCE	ADMI.	A	A	
10	COLOR TELEVISION	NATIONAL TVC-VG60	2	1	B	39,150.00	TCE	ADMI.	B	A	
11	DUPLICATOR WITH CABINET	GESTETNER	2	1	B	68,000.00	TCE	ADMI.	A	A	
12	WIRE STITCHING MACHINE	PAUL MODEL 747	2	1	B	67,500.00	TCE	ADMI.	B	A	
13	VIDEO CAMERA	NATIONAL MODEL NV-M7	2	1	B	48,100.00	TCE	ADMI.	B	A	
14	SLIDE PROJECTOR	OMNIGRAPHIC.252	2	1	B	31,140.00	TCE	ADMI.	A	A	
15	PORTABLE REFRIGERATOR	MPFT-560	2	2	B	64,440.00	TCE	ADMI.	B	A	
16	CHELF		2	1	B	25,000.00	TCE	AGRO.	A	A	
17	KERNEL MOISTURE METER	CTR-160A	2	1	B	134,000.00	TCE	AGRO.	A	A	
18	TAYON PC	386 SX S/NO B-0066	2	1	B	73,000.00	TCE	AGRO.	A	A	
19	SELF BALANCING RECORDER	P/N M-182	2	1	B	136,290.00	TCE	AGRO.	B	A	
20	FUME HOOD (WOOD)		2	2	B	128,000.00	TCE	AGRO.	A	A	
21	WIND CONVERTOR	P/N M-821	2	1	B	86,250.00	TCE	AGRO.	B	A	
22	LAMINAR FLOW	ISSCO	2	1	B	110,000.00	TCE	AGRO.	B	A	
23	P.D. HUMIDITY METER	HN-D19	2	2	B	84,000.00	TCE	AGRO.	A	A	
24	SUNSINE SENSOR	P/N H-061	2	1	B	109,250.00	TCE	AGRO.	A	A	
25	AIR SAMPLER	NIHON GENERAL SAS	2	1	B	120,000.00	TCE	AGRO.	A	A	
26	SOIL TEMPERATURE	P/N E-733	2	1	B	22,977.00	TCE	AGRO.	A	A	
27	TOKUSHU BLENDER	AM-M (2L)	2	1	B	166,000.00	TCE	AGRO.	B	C	power source
28	SAMPLE CONCENTRATOR	M6-1	2	1	B	35,000.00	TCE	AGRO.	B	A	

主要機材利用／保守管理状況

LIST OF EQUIPMENT FROM JICA (1990)

CLASS 1 = > 300,000B OR 1,600,000¥

CLASS 2 = < 1, .>20,000 OR 100,000¥

NO	N A M E	M O D E L	QNT.	CLASS	CRY	P R I C E	CAT.	SECTION	USE	MAIN	R E M A R K S
1	Portable Photosynthesis	Licor LI-6200	1	1	B	750,000.00	TCE	Agro.	A	A	
2	Main Controller	Model N-801	1	1	B	604,000.00	TCE	Agro.	C	A	Under adjasting
3	Delta Logger	LAC1	4	2	B	300,200.00	TCE	Agro.	C	A	〃
4	Leaf Area Meter	AAM-8	1	2	B	275,000.00	TCE	Agro.	A	A	
5	Kubota Farm Tractor	L2050/4WD	1	2	B	250,000.00	TCE	Agro.	A	A	
6	Lap - Top Computer	Use for data logger	2	2	B	240,000.00	TCE	Agro.	C	A	Under adjasting
7	Solar Radiation sensor	H-201	1	2	B	151,515.00	TCE	Agro.	C	A	〃
8	Printer	Model M-948	1	2	B	125,000.00	TCE	Agro.	A	A	
9	Kobashi Rotary	M. S. 60	1	2	B	89,000.00	TCE	Agro.	A	A	
10	Sili, Voltage Stabilizer	LC-107	1	2	B	80,000.00	TCE	Agro.	A	A	
11	Spare Parts Kit	Licor LI-SP-6200	1	2	B	72,000.00	TCE	Agro.	A	A	
12	Sartorius	E 5500 s 5,500 gm,	1	2	B	72,000.00	TCE	Agro.	A	A	
13	Gas Calibration Cylinder	Licor LI-6000-01	1	2	B	55,400.00	TCE	Agro.	B	A	
14	Maize sheller	Alvan Blanch Abms	1	2	B	51,000.00	TCE	Agro.	A	A	
15	ATM Maize seeder	P. F. -862	1	2	B	45,000.00	TCE	Agro.	A	A	
16	Generator	EM4500SX	1	2	B	40,900.00	TCE	Agro.	B	A	
17	Four Liter Chamber	Licor LI-6000-10	1	2	B	40,000.00	TCE	Agro.	A	A	
18	Quater Liter Chamber	Licor LI-6000-13	1	2	B	40,000.00	TCE	Agro.	B	A	
19	Memory card	M/B 386 SX RAM 6 MB	1	2	B	30,000.00	TCE	Agro.	A	A	
20	Epson LQ plus printer	1050	1	2	B	26,000.00	TCE	Agro.	A	A	

主要機材利用／保守管理状況　　CLASS 1 = > 300,000B OR 1,600,000¥

LIST OF EQUIPMENT FROM JICA (1990)　　CLASS 2 = < 1, .>20,000 OR 100,000¥

NO	N A M E	M O D E L	QNT.	CLASS	CRY	P R I C E	CAT.	SECTION	USE	MAIN	R E M A R K S
21	Komatsu Forklift	FG10NT-15	1	1	B	450,000.00	TCE	P.HAR	A	A	
22	Shaphers Made in U.S.S.R.	Model 7305-T Max.	1	2	B	182,000.00	TCE	P.HAR	A	A	
23	Load cell Orientec	CMX-200 L.	4	2	B	147,320.00	TCE	P.HAR	A	A	
24	Chemical Blance Mettler	AE 200	1	2	B	95,700.00	TCE	P.HAR	A	A	
25	Electric Balance Mettler	PM 4000	1	2	B	72,500.00	TCE	P.HAR	A	A	
26	Desiccator	Sokiya	2	2	B	65,250.00	TCE	P.HAR	A	A	
27	Vacuum Pump	PD-52	1	2	B	65,000.00	TCE	P.HAR	B	A	
28	V.S. Motor 3	HP. 380.50 HZ.	1	2	B	23,955.00	TCE	P.HAR	A	A	
29	Psychrometer Assmann	YAMATO GM	1	2	B	21,460.00	TCE	P.HAR	A	A	
30	Shimadzu GasChromatograph	GC-8 APT	1	2	B	287,680.00	TCE	MICRO	B	A	
31	Kodak Slide	S-AV 2050 AF	1	2	B	47,900.00	TCE	MICRO	A	A	
32	Kodak Overhead Projector	Ektalite R 3 10-1109	1	2	B	31,500.00	TCE	MICRO	A	A	
33	Moisture meter for soil	J3	1	2	B	24,275.00	TCE	MICRO	B	A	

主要機材利用／保守管理状況　　CLASS 1 = > 300,000B OR 1,600,000¥

LIST OF EQUIPMENT FROM JICA (1990)　　CLASS 2 = < 1, .>20,000 OR 100,000¥

NO	N A M E	M O D E L	QNT.	CLASS	CRY	P R I C E	CAT.	SECTION	USE	MAIN	R E M A R K S
34	IBM Personal System/2	Model 8570/A21	1	1	B	310,000.00	TCE	ADMI.	B	A	
35	IBM Personal System/2	Model 8555/F61	2	2	B	316,000.00	TCE	ADMI.	B	A	
36	Ricoh Copier Machine	FT-5590	1	2	B	210,000.00	TCE	ADMI.	A	A	
37	Dot-Matrix Printer Epson	LQ-2550	2	2	B	106,000.00	TCE	ADMI.	B	A	
38	Token-Ring Adapter/A	Model 69X8138	3	2	B	78,000.00	TCE	ADMI.	B	A	
39	External Tape Drive	Use for Computer	1	2	B	70,000.00	TCE	ADMI.	B	A	
40	UPS-7019 Back Up 500	QUASAR	3	2	B	66,000.00	TCE	ADMI.	B	A	
41	Dot-Matrix Printer	PR-PR201 HE-2	1	2	B	57,000.00	TCE	ADMI.	B	A	
42	Slide Kodak	Model 575 AF	1	2	B	50,500.00	TCE	ADMI.	A	A	
43	Olympia Electronic type.	Supertype 230 BT	1	2	B	48,000.00	TCE	ADMI.	A	A	
44	Sorter	CH-2080	1	2	B	45,000.00	TCE	ADMI.	A	A	
45	Document Feeder	DF-51	1	2	B	45,000.00	TCE	ADMI.	A	A	
46	Multi Station Access Unit	Model 6091014	1	2	B	27,000.00	TCE	ADMI.	B	A	
47	Atto. Electrophoresis Set	Use for experiment	1	2	¥	314,990.00	ACC	MICRO	B	A	

Document No. D

List of Equipments/Furnitures for the Maize Quality Improvment Centre. (RTG Budget : 1988 Fiscal Year)

No.	Items	Amount (Set)	Unit Price (Baht)	Total (Baht)
1.	Desks with chairs (Level 1-2)	2	719	1,438
2.	Desks with chairs (Level 3-6)	20	1,340	26,800
3.	Desks with chairs (Level 7-8)	2	2,240	4,480
4.	Typewriter table with chair	1	800	800
5.	Chairs (Level 1-2)	22	130	2,860
6.	Meeting table with chairs	1	7,750	7,750
7.	Telephone table	7	150	1,050
8.	Sofa	1	4,500	4,500
9.	Cabinets (4 drawers)	6	1,390	8,340
10.	Cabinets (3 drawers)	4	1,195	4,780
11.	Cabinet	1	1,370	1,370
12.	Knock down shelf	1	1,170	1,170
13.	White board	4	470	1,880
14.	Printing machine	1	42,700	42,700
15.	Electric typewriter	1	20,500	20,500
16.	Calculator	1	2,700	2,700
17.	Telephone	1	89,500	89,500
	Total			222,618

メイズ

１．タイのメイズ（飼料用とうもろこし）の生産は、１９６０年には５０万トン程度の生産量に過ぎなかったが、近年の生産量は４００万トンを超えるまでに急成長した。この急成長の原因は、昭和３０年代の日本の畜産の急成長の過程で、タイが飼料用とうもろこしの供給基地となり、その生産を急拡大したことによる。

２．メイズの生産量は１９６０年に５０万トンを超え、１９６５年には１００万トン、１９７０年には２００万トン、１９８０年には３００万トンと急激な生産拡大を遂げ、１９８４年には４６０万トンに達した。一方、日本向け輸出量は、１９６０年には４５万トン（同年のタイの輸出量の８５％）であったが、その後の二国関取り極めに基づき日本向け輸出量が拡大され、最盛期の１９７１年には９８万トン（同年のタイの輸出量の４８％）と、１００万トン水準の日本向け輸出となった。

しかし、その後、発ガン性を有するカビ毒であるアフラトキシンの汚染問題が発生し、１９８２年からは日本向け輸出がゼロとなった。当時は、二国関取り極めに基づき輸入を強く迫るタイと、それを拒む日本との間で大きな紛争となった。しかし、その後、マレーシア、中近東等における畜産の成長から、それらの国からの輸入意欲の増加に助けられ、日本向け輸出を念頭において生産を拡大したタイのメイズは、他の国々への販路を確保できた。

なお、メイズの大輸出国であるタイも、近年、タイ国内での鶏肉生産の拡大等から国内での飼料需要が強まり、輸出がなかなか困難になりつつある状況にある。

３．現在のメイズの生産状況を地域別にみると、１９８９／９０年において全作付面積は約１，１２０万ライ（約１８０万ｈａ）で、このうち東北タイが全体の２８％を占める約３１１万ライ（約５０万ｈａ）で、北部タイが全体の４６％を占める約５１６万ライ（約８２万ｈａ）で、中部タイが全体の２６％を占める約２８７万ライ（約４６万ｈａ）で、南部タイは全体の０．３％を占める約４万ライ（０．６万ｈａ）となっている。

メイズの生産量の推移

年	作付面積（千ライ）	収穫面積（千ライ）	収穫量（千トン）	単位収量（kg/ライ）
80／81	8,960	8,409	2,998	357
81／82	9,796	9,157	3,449	377
82／83	10,494	8,163	3,002	368
83／84	10,552	9,792	3,552	363
84／85	11,355	10,866	4,226	389
85／86	12,377	11,990	4,934	412
86／87	12,194	11,345	4,309	380
87／88	10,941	8,484	2,781	328
88／89	11,471	11,163	4,675	419
89／90	11,165	10,687	4,393	411

（資料：Agricultural Statistics of Thailand, MOAC）

（注）１ライ＝０．１６ｈａ

メイズの地域別生産量

地　域	年	作付面積（千ライ）	収穫面積（千ライ）	収穫量（千トン）	単位収量（kg/ライ）
東北タイ	86/87	3,284	2,956	1,049	355
	87/88	2,763	2,402	783	326
	88/89	3,092	3,024	1,266	419
	89/90	3,107	2,989	1,152	385
北部タイ	86/87	5,755	5,566	2,130	383
	87/88	5,137	3,649	1,168	320
	88/89	5,276	5,136	2,158	420
	89/90	5,156	4,945	2,047	414
中部タイ	86/87	3,139	2,806	1,125	401
	87/88	3,015	2,409	825	342
	88/89	3,071	2,972	1,241	418
	89/90	2,866	2,719	1,183	435
南部タイ	86/87	16	16	4	249
	87/88	25	23	5	226
	88/89	32	30	9	299
	89/90	35	33	10	311
合　計	86/87	12,194	11,345	4,309	380
	87/88	10,941	8,484	2,781	328
	88/89	11,471	11,163	4,675	419
	89/90	11,165	10,687	4,333	411

（資料：Agricultural Statistics of Thailand, MOAC）

（注）１ライ＝０．１６ｈａ

メイズの輸出状況

（単位：千トン）

国　名	１９８５	１９８６	１９８７	１９８８	１９８９
マレイシア	911	968	794	423	710
シンガポール	369	400	218	91	128
香　港	91	172	144	99	100
中　国	61	591	82	-	-
韓　国	460	1,058	49	459	45
サウジアラビア	214	322	167	47	4
フィリピン	141	-	56	-	146
そ の 他					
合　計	2,782	4,013	1,649	1,214	1,182

（出所：Bank of Thailand）

収穫年次	作付面積	収穫面積	生産量	単収	価　格	生産額	輸出量	出／生
	(ha)	(ha)	(M.ton)	(t/ha)	(FP/Yen)	(Mil.Yen)	(M.ton)	(%)
1951	40,000	--	27,700	0.755	--	--	--	--
1952	46,600	--	41,600	0.975	--	--	--	--
1953	48,000	--	50,000	0.875	--	--	--	--
1954	52,000	--	63,300	1.075	--	--	--	--
1955	57,000	--	83,700	1.152	--	--	--	--
1956	60,000	--	69,400	1.198	--	--	--	--
1957	90,600	--	113,800	1.350	--	--	--	--
1958	94,600	--	136,100	1.375	--	--	--	--
1959	126,600	--	191,600	1.425	--	--	--	--
1960	193,300	--	330,500	1.530	--	--	--	--
1961	286,600	--	564,800	1.833	--	--	--	--
1962	300,000	--	616,200	1.880	--	--	--	--

収穫年次	作付面積	収穫面積	生産量	単収	価　格	生産額	輸出量	出／生
1963	328,000	321,440	665,400	2.031	--	--	--	--
1964	417,920	388,480	857,700	2.050	--	--	--	--
1965	551,840	541,440	935,100	1.694	--	--	831,353	106.5
1966	576,800	561,600	1,021,300	1.769	--	--	1,251,556	106.5
1967	653,440	590,240	1,132,400	1.719	--	--	1,145,981	102.1
1968	744,160	669,600	1,217,400	1.638	5.8	7,085.4	1,558,198	128.0
1969	762,080	692,320	1,331,000	1.744	4.3	4,682.5	1,544,815	116.1
1970	679,680	--	1,700,000	2.500	4.6	6,921.9	1,447,955	85.2
1971	828,800	--	1,938,200	2.338	5.1	9,568.5	1,873,461	96.7
1972	1,018,880	--	2,300,000	2.256	4.2	7,872.0	1,843,619	(89.4)
1973	996,960	--	1,315,000	1.319	5.2	6,786.2	1,386,376	(89.4)
1974	1,147,520	--	2,339,000	2.038	8.1	18,933.6	2,301,576	98.4

収穫年次	作付面積	収穫面積	生産量	単収	価　格	生産額	輸出量	出／生
1975	1,239,840	--	2,500,000	2.019	12.4	30,877.3	2,104,733*	84.2
1976	1,311,923	--	2,863,168	2.181	11.1	31,963.1	2,419,186	84.5
1977	1,284,689	1,121,120	2,675,195	2.081	10.0	26,805.6	1,541,957	(80.8)
1978	1,205,428	976,000	1,676,518	1.456	9.8	16,497.0	1,972,446	(80.8)
1979	1,385,809	1,313,760	2,790,575	2.013	9.8	26,956.8	2,013,985	72.2
1980	1,524,709	1,424,320	2,863,201	1.875	12.5	35,904.6	2,202,510	76.9
1981	1,433,636	1,345,440	2,997,882	2.094	14.6	43,709.4	2,574,608	85.9
1982	1,567,283	1,465,120	3,448,538	2.200	13.1	45,106.8	2,830,701	82.1
1983	1,679,065	1,306,033	3,002,304	2.300	12.2	36,748.2	2,658,679	88.6
1984	1,688,312	1,566,726	3,552,391	2.269	14.9	53,073.0	3,144,605	88.5
1985	1,816,823	1,738,594	4,225,572	2.431	14.0	59,073.6	2,781,994	(74.2)
1986	1,960,338	1,918,449	4,934,118	2.575	10.9	53,880.6	4,013,263	(74.2)

収穫年次	作付面積	収穫面積	生産量	単収	価　格	生産額	輸出量	出／生
1987	1,950,973	1,815,137	4,308,768	2.375	9.6	41,364.0	1,649,179	38.3
1988	1,750,566	1,357,467	2,780,862	2.050	14.9	41,379.0	1,214,498	43.7
1989	1,835,408	1,786,066	4,675,163	2.619	15.7	73,493.4	1,126,082	24.1
1990	1,820,800		4,460,000	2.450				
1991	0							

③ 各分野プログレスレポート

1）業務調整部門

PROGRESS REPORT (Japanese side)
(March 1988)

I. Expert Dispatch

1. Long term experts have been dispatched on fields of Team Leader, Project Coordinator, Post-harvest and Agronomy on July 21, May 20 and June 30 of 1987 respectively.

   Microbe expert requested is not able to be dispatched at present. The project is asking to Japanese side to arrange it as soon as possible.

2. Short term experts were dispatched as following:

   1) Mr. Yoshiro Ideguchi: Civil engineer
   First visit: His duty was to design and cost estimate for fixing water-reservoir at Phraphuttabaht Field Crops Experiment Station, from December 15 to December 26, 1987. He finished his duty and went back to Japan on the scheduled term.

   Second visit: He carries out his duty as a supervisor on the construction work for the water-reservoir at the site until end of the work, from March 10 to June 17, 1988.

   2) Mr. Hidekazu Shimada: Microbe Expert
   His duty was to discuss and make Project Implementation Plan with Thai counterparts on the respected field, from January 11 to March 10, 1988. He finished his duty and went back to Japan on the scheduled term.

   3) Mr. Yuzuru Tomioka: Civil Engineer
   He works on preparation and proceeding with the contract of the construction for the water-reservoir, from March 10 to April 8, 1988.

II. Counterpart Training

Two counterparts, Mrs. Sriwai Singhagajen and Mr. Narongsak Senanarong, were sent to Japan from September 28 to October 17, 1987 for study tour. They visited various Institutions on respected fields.

III. Equipment and Materials

5.1 million Yen in 1986 Japanese fiscal year was provided for two vehicles and office equipment. In 1987 Japanese fiscal year, out of total 26.172 million Yen was provided as equipment and material for General, Agronomy, Post-harvest and Microbe fields, 2.175, 7.014, 8.118, and 8.865 million Yen respectively and 3.06 million Baht was

provided for water-reservoir construction at Phraphuttabaht Field Crop Experiment Station.

IV. Project Activities

1. The team and Thai counterparts of Agronomy and Agricultural Engineering Fields took a field trip to northeast of Thailand from October 5 to October 9, 1987. The trip was made in order to observe agricultural production emphasized on field crops and also discuss with researchers of Field Crop Research Institutions on their activities and agricultural situations in the region.

2. In the field of Post-harvest, Mr. M. Kobayashi and three Thai staff visited major maize growing area, Nakhon Sawan, Petchabun, Loei and Nakhon Rachasima in order to investigate the practical condition on maize cultivation, harvesting and storing. The survey was carried out from December 1 to December 30, 1987. The results are preparing for the report at present.

3. Mr. T. Nibe moved his station from Bangkhen to Phraphuttabaht in order to carry out his duty on agronomy, since December, 1987.

4. Dr. T. Yoshiyama, Team Leader, attended for the Project Leader's Meeting held in Tokyo from January 17 to 24, 1988.

V. Project Office

The office of the Japanese Team is supposed to move from the tentative room which located at 5th floor of DOA main building to the Centre building in middle of April 1988.

PROGRESS REPORT (Japanese side)
(March 1989)

I. Dispatch of Experts

1. Long Term Experts

In the 1987 Japanese fiscal year, four long term experts have already been dispatched, and in the 1988 Japanese fiscal year Mr. Arai, expert in the microbe research, was dispatched. Now, five staffers, all long term experts scheduled under the R/D are assigned. (refer to the attached paper VI-(2))

Home Leave of experts:

Mr. M. Kobayashi: June 14 - July 13, 1988
Mr. T. Seino : August 6 - August 30, 1988
Dr. T. Yoshiyama: September 12- October 11, 1988

2. Short Term Experts

1) In the 1987 Japanese fiscal year, two civil engineers, Mr. Ideguchi and Mr. Tomioka were assigned on March 10, 1988. Mr. Ideguchi's duty was to supervise the fixing of the water-reservoir at Phraphuttabaht Field Crop Experiment Station. He finished his duty and went back to Japan on June 17, 1988, on schedule. Mr. Tomioka's responsibility was to negotiate the contract for fixing the above mentioned water reservoir. He also completed his duty and went back to Japan on April 8, 1988.

2) In the 1988 Japanese fiscal year, to emphasize the research activities concerning the post-harvest area, three experts were assigned. They were Mr. Azuma for corn sheller improvement from July 20 to September 19. Mr. Kamo for ammonia treatment from July 20 to September 19. Mr. Ishitani for improving the moisture meter from August 1 to August 21. They finished their duty and went back to Japan at the scheduled time.

3) For strengthening the study in the microbe research area, Dr. Tsuruta was dispatched from August 19 to September 27. His duty was to study the characteristics of the Aspergillus spp. for the prevention of Aflatoxin contamination of maize. Also, he was to instruct Thai counterparts in the evaluation methods of infected maize kernel.

II. Counterpart Training

In the 1988 Japanese fiscal year, four counterparts have

been arranged as staffers for training. Three of them finished their duty and came back to Thailand, and one of them is expected to be sent to Japan in March, 1989. They are Miss Arunsri Wongurai, Mr. Sukapong Vayuparp, Dr. Maitri Naewbanij and Dr. Vijai Nopamornbodi.

Miss Arunsri Wongurai, counterpart for microbe research, stayed at the National Food Research Institute, MAFF, for four months, from May 16 to September 15, 1988.

Mr. Sukapong Vayuparp, counterpart for agronomy, stayed at the Miyakonojo Branch, Miyazaki Prefectural Agricultural Experiment Station for four months, from June 20 to October 21, 1988.

Dr. Maitri Naewbanij, counterpart for post-harvest studies, stayed at the National Grassland Research Institute, MAFF, for eight weeks, from October 2 to November 30, 1988.

Dr. Vijai Nopamornbodi, counterpart for administration, is taking a study tour on agricultural policy and management concerning research work at several Institutes in Japan for three weeks, from March 6 to March 24, 1989.

III. Equipment and Facilities

The equipment provided by grant aid started to be used after the opening ceremony.
In the 1987 fiscal year, 26.430 million Yen (Baht 5,024,770) out of the budget for technical cooperation was provided for equipment. Agronomy, post-harvest studies and microbe research received 7.603 Million Yen (B 1,445,200), 12.435 million Yen (B 2,364,050) and 6.392 million Yen (B 1,215,300) respectively. An exchange rate of 1 Baht = 5.26 Yen is used throughout the report. A list of the equipment is to be found attached to the end of this report. (VI - (8))

3.06 million Baht was provided for water reservoir construction at Phraphuttabaht Field Crop Experiment Station. The construction was duly completed and the final inspection was finished by the Inspection Committee Members on June 14, 1988. The reservoir and irrigation facilities were handed over by the Resident Representative of the Thailand Office, JICA to the Director- General of the Department of Agriculture, MOAC on June 15, 1988.

In the 1988 Japanese fiscal year, 42.500 million Yen (Baht 8,079,000) was provided for equipment for technical cooperation. The equipment was selected according to the discussion in the counterpart group of the Project and the list was sent to the JICA headquarters in July, 1988.

IV. Project Activities

1. Dr. T. Yoshiyama, Mr. T. Seino, Mr. M. Kobayashi and Thai counterparts concerned participated in the DOA Annual Conference held at Surat Thani, from April 17 to April 22, 1988. Dr. T. Yoshiyama gave a presentation titled "The Outline of the Maize Quality Improvement Research Centre Project". (refer to the attached paper VI - (4))

2. Mr. T. Nibe attended the 19th National Corn and Sorghum Reporting Session held at Surat Thani from July 12 to 15, 1988.

3. A Training course on the prevention of aflatoxin in maize was held at Bangkhen, from September 14 to September 20, 1988. Mr. K. Arai gave a lecture on "Sample handling and Sample Preparation", on September 19th. Participants in the above course visited the MQIRC on September 20, 1988. (refer to the attached paper (VI - (5))

4. Dr. T. Yoshiyama, Mr. T. Seino, Mr. T. Nibe and Mr. M. Kobayashi attended the inauguration of the AGPP (The ASEAN Grain Post-harvest Programme) headquarters, Bangkhen on October 21, 1988.

5. Mr. K. Arai and Mr. M. Kobayashi attended the Campaign Against Aflatoxin Day, organized by DOAE and DOA, MOAC, Nakhon Sawan, on September 29, 1988. (refer to the attached paper (VI -(6))

6. Mr. M. Kamo attended a meeting organized by the Post-Harvest Section and gave a presentation, "Directions and Precautions for Handling of Ammonia.", on August 15, 1988. (refer to the attached paper (VI - (7))

7. Dr. T. Yoshiyama, Team Leader, attended for the Project Leader's Meeting held in Tokyo from January 29 to February 9, 1989.

8. Research Activities
   A series of experiments have been carried out under the Tentative Implementation Programme, which were confirmed at the Joint Committee Meeting on April 5, 1988. The main subjects implemented in three fields are as follows :

   1) Agronomy
   The main targets in this year were set on the correlation between cultural practices and aflatoxin contamination. Five experiments concerned with variety, planting time, cropping system, plant density and Nitrogen application, irrigation, harvesting time and methods, and climatological

conditions have been carried out. Regarding aflatoxin contamination, 512 samples have been sent to the Microbe section and 36 of them have been analyzed up to now. Aspergillus spp. infection has been observed in the 120 soil samples collected from the crop rotation field.

2) Post-Harvest Studies
In this field, four subjects of the scheduled five subjects have been studied. They are: corn sheller improvement, ammonia treatment, improvement of the moisture meter and trickle ammonia drying method. For analyzing aflatoxin contamination, 1,022 samples were sent to the Microbe Section, of which 211 samples have been examined. On the other hand, 287 samples derived from the ammonia treatment were inspected for the infection caused by Aspergillus spp. Regarding the survey, "The Present Situation in Farmers and Middlemen", the results of last year were settled for the report, but the investigation this year has not been done yet.

3) Microbe Research
This field is closely related to the Agronomy and the Post-Harvest fields. A number of samples derived from the studies in the Agronomy and the Post-Harvest fields were handed over to the Microbe field in order to examine the aflatoxin contamination.

The total number of samples which need to be inspected by the Microbe Section is 1,941 this season. In order to inspect a lot of samples given by the other two sections, the Microbe Section suggests using a visual check method. This method would be able to treat many samples at one time. Basic analytical and microbiological techniques are transferred to junior technicians in this field.

V. Project Office

The project office moved from the temporary room which was located on the 5th Floor of DOA Main Building to the centre building on May 9, 1988.

VI. Conclusion

This is an outline of the present situation of the project activities conducted so far. The details of the research activities related to the survey, experiments and related general issues were discussed and reviewed by the visiting Japanese Technical Guidance Team and the Working Group of the Project.
The results of the discussion will be summarized and proposed to the Joint Committee Meeting for final consideration and adoption by the Japanese Technical Guidance Team.

PROGRESS REPORT (Japanese side)
(March 1990)

I. Dispatch of Experts

1. Long Term Experts

Four long-term experts in the 1987 Japanese fiscal year and one long-term expert in 1988 Japanese fiscal year have been dispatched. Mr. Makoto Kobayashi, expert to the Post-Harvest Section, finished his two and a half years term of duty, which has been extended for six months from the primary schedule, and went back to Japan on November 19, 1989.

The term of duty of Mr. Takeji Seino, Coordinator, Mr. Teruhiko Nibe, expert to the Agronomy Section and Mr. Katsusuke Arai, expert to the Microbe Section were extended for one year over their scheduled terms.

Dr. Taketoshi Yoshiyama, Team Leader, has finished his scheduled two years and five extra months on December 20, 1989, and on that date went back to Japan. As a successor of Dr. T. Yoshiyama, Mr. Seiichi Ueda was assigned as the Team Leader on December 8, 1989. Mr. Mitsuhisa Harada, expert to the Post-Harvest Section was also dispatched as a successor to Mr. M. Kobayashi on December 8, 1989. (refer to Annex I)

2. Short Term Experts

In the 1989 Japanese fiscal year, in order to emphasize the research activities, seven experts have been dispatched as follows :

1) Agronomy Section :

Mr. Mikinori Tsuiki, expert concerning the Agronomy Section was dispatched on September 27, 1989. His duty was to formulate a simulation model of maize production at Phra Phutthabat Field Crops Experiment Station. He finished his duty and went back to Japan on November 26, 1989, on schedule. (refer to Annex I)

2) Post-Harvest Section :

In order to emphasize the research activities concerning the Post-Harvest Section, four experts were assigned. They were Mr. Yukio Azuma for corn sheller improvement from July 6 to November 5, 1989. Mr. Mikio Kamo for ammonia treatment from July 6 to August 24, 1989, Mr. Keiichi Inoue for developing the drying method of post-harvest maize from July 25 to September 24, 1989 and Mr. Nobuyoshi Ishitani for improving the moisture meter from August 1 to September 9, 1989. They

finished their duties and went back to Japan at the schedule time. (refer to Annex I)

3) Microbe Section :

For strengthening the study in the Microbe Section, two experts, Dr. Tsuruta and Mr. Goto were assigned on July 16 and September 14, 1989, respectively. Dr. Tsuruta's duty was to study the characteristics of the Aspergillus spp. for the prevention of aflatoxin contamination of maize. Mr. Goto's responsibility was to improve the analysis methods of maize kernel contaminated by aflatoxin. They finished their duties and went back to Japan on August 15 and December 12, 1989, respectively. (refer to Annex I)

II. Counterpart Training

In the 1989 Japanese fiscal year, four counterparts have been selected as staff for training. Three of them finished their duties and came back to Thailand, and one is still in Japan for training. They are Mr. Prasop Depayasuvarn, Mr. Chaiwat Paosantadpanich, Mr. Suparat Kositchareonkul and Mrs. Siriporn Sindhusake, respectively.

Mr. Prasop Depayasuvarn, the counterpart for agronomy, stayed at the National Grassland Research Institute, M.A.F.F. for 45 days from July 10 to September 2, 1989.

Mr. Chaiwat Paosantadpanich, the counterpart for post-harvest studies, was staying at the National Grassland Research Institute, M.A.F.F. for 91 days from October 30, 1989 to January 28, 1990.

Mr. Suparat Kositchareonkul, the counterpart for microbe research is stayed at the National Food Research Institute, M.A.F.F. for three months, from January 14 to April 17, 1990. He has been studied the aflatoxin analysis and the physiology of A. flavus.

Mrs. Siriporn Sindhusake, the counterpart for administration, took a study tour on agricultural administration and management concerning research work at several institutes in Japan for three weeks from March 5 to March 28, 1990. (refer to Annex II)

III. Equipment and Facilities

Laboratory equipment purchased in the 1988 Japanese fiscal year is in the list of equipment attached to this paper.

In the 1989 Japanese fiscal year (from April 1, 1989 to March 31, 1990), 62.000 million Yen (Baht 11,923,000) of the budget for equipment was requested and 60.000 million Yen (Baht 10,526,310) is allocated at present. The equipment was

requested to JICA on April 1989 according to the discussion in the counterpart groups of the project. Facility construction of Baht 1,014,139 has been approved in the end of March 1990 based on the exchange of verbal note. (refer to Annex III)

IV. Project Activities

1. Dr. T. Yoshiyama, Mr. T. Seino, Mr. T. Nibe, Mr. M. Kobayashi, Mr. K. Arai and Thai counterparts concerned participated in the DOA Annual Conference held at Khon Kaen from April 24 to April 28, 1989. Mr. T. Nibe gave a presentation titled "Agronomical Approach on Maize Quality Improvement". Mr. M. Kobayashi has been reported title of "The Studies on the Post-Harvest Operation for Controlling Aflatoxin Contamination of Maize". And Mr. K. Arai gave a presentation title "Ammonia Treatment of Maize to Control A. flavus Infection and Aflatoxin Contamination"

2. A training course in mycotoxin prevention and control was held at Bangkhen from July 31 to August 12, 1989. The following papers were presented by following project staff:
   1) Mr. T. Nibe : "Field Management to Control Mycotoxin"
   2) Mr. M. Kobayashi : "Corn Sheller and Moisture Meter"
   3) Dr. Mitri Naewbanij : "Batch Dryer and Continuous Flow Dryer"
   4) Mrs. Prisnar Siriacha : "Bright Greenish Yellow Fluorescence Test (BGYF)"
   5) Mr. Prawat Tanboon-ek : "Aflatoxin Control in Thai Maize"

   Laboratory work on "Sample Preparation and BGYF test" was demonstrated by Miss Arunsri on August 8, 1989. Participants in the above course visited the MQIRC on August 7, 1989. Dr. T. Yoshiyama gave a presentation "On the History of the MQIRC and the Project Activities". Mr. K. Arai and Miss Arunsri Wongurai instructed in the use of the experimental equipment and facilities. (refer to the attached paper IV-(5))

3. The second field trip and spot discussion of the four sections were held at Phra Phutthabat Field Crops Experiment Station on November 1st, 1989.

4. The 100th meeting of "the Agricultural Seminar" organized by TARC was held on December 1st, 1989 at the meeting room of the Japan External Trade Organization (JETRO). Dr. T. Yoshiyama, Mr. T. Seino, Mr. T. Nibe, Mr. K. Arai, Mr. T. Goto and 20 other members concerned attended. Dr. Yoshiyama gave a presentation on the organization system of the MQIRC and research activities.

5. Research Activities
   A series of experiments has been carried out under the Tentative Implementation Program, which were confirmed at

the Joint Committee Meeting on March 16, 1989. The main subjects implemented in three sections are as follows :

1) Agronomy Section
Total eleven research subjects were proposed in agronomy section. Ten subjects were already completed. Field experiments were carried out from April 14 to beginning of March. One subject "Relation between Kernel Type and Resistance to Fungus Infection after Inovulation" was delayed due to postponed seed multiplication by field arrangement, that will be carried out end of April to early May. General conditions for maize growing was less rainfall than 1988 and its distribution was also not preferable especially in early growth period. Over one thousand four hundred samples including soil, maize and air were taken for analysis of aflatoxin, A. flavus and soil chemical properties. Level of aflatoxin in granule was not high as 1988.

2) Post-Harvest Section
Main activities of this year were divided into four categories. For corn sheller improvement, seven types of cylinders were tested to get data for the prototype of improved corn sheller. For moisture meter, standardization of the oven method and calibration test of moisture meters were under investigation and moisture meter for ear maize was newly developed and tested. For chemical treatment, ammonia and sulfur dioxide treatment during storage were examined and trickle drying process using ammonia or sulfur dioxide (TAP, TSDP) was investigated. And for storage and drying, increase of damaged kernel during handling, effect of delayed drying in the post-harvest process and internal environment of farmers storage were analysed, and simple drying method was investigated. Last year one hundred and twelve samples were sent to Microbe Section for aflatoxin analysis.

3) Microbe Section
This field has close relations with the Agronomy and Post-Harvest research. In 1989, crop season, 526 of maize samples for aflatoxin analysis, 235 of maize samples and 288 of soil samples for microbiological studies were received from the Agronomy Section. The Post-Harvest Section sent 112 of maize samples to the Microbe Section for aflatoxin analysis, both shelling and drying experiments.
The Microbe Section carried out their three main subjects, viz. physiological and ecological study on A. flavus, analytical method of aflatoxin and physical properties of maize kernels. About 500 of maize samples in field, trade and storing were analyzed on aflatoxin, and more than 400 of maize and soil samples were used for microbiological studies. Both the microbiological techniques and the analytical method of aflatoxin by means of Immunoassey were transferred to the junior scientists in the section.

PROGRESS REPORT (Japanese side)
(January 1991)

I. Dispatch of Experts

1. Long Term Experts

Three long-term experts in 1990 Japanese fiscal year have been extended their scheduled term. The terms of duty of Mr. Takeji Seino, Coordinator, Mr. Teruhiko Nibe, expert to the Agronomy Section and Mr. Katsusuke Arai, expert to the Microbe Section were extended for about one year and half over their scheduled terms until 14 December, 1991. (refer to Annex I)

2. Short Term Experts

In the 1990 Japanese fiscal year, in order to emphasize the research activities, eight experts have been dispatched as follows :

1) Agronomy Section :

In this year, three short-term experts were dispatched for this section. Mr. Osamu Saito, Mr. Mikinori Tsuiki and Mr. Yoshimitsu Saito, those who were dispatched from October to December in 1990. Dr. O. Saito's duty was evaluation of insect damage on maize in Thailand and he finished his duty and went back to Japan on December 2, 1990. Mr. M. Tsuiki's duty was to formulate a simulation model of maize production at Phra Phutthabat field Crops Experiment Station. He finished his duty and went back to Japan on December 16, 1990, on schedule. Mr. Y. Saito's duty was measurement of photosynthesis on maize, at Phra Phutthabat field Crops Experiment Station. He finished his duty and went back to Japan on December 24, 1990 at the schedule time. (refer to Annex I)

2) Post-Harvest Section :

In order to emphasize the research activities concerning the Post-Harvest Section, two experts were assigned. They were Mr. Yukio Azuma for corn sheller improvement from July 20 to November 3, 1990, Mr. Akira Matsuzaki for simple drying method of maize for farmers from August 21 to November 18, 1990, they finished their duties and went back to Japan at the schedule time.(refer to Annex I)

3) Microbe Section :

For strengthening the study in the Microbe Research Section, three experts, Dr. Michihiko Saito and Dr.

Toshitugu Tanaka and Prof. Dr. Micho Kosaki were assigned on August 20, October 4 and December 4, 1990, respectively. Dr. M. Saito's duty was to study the characteristics of the Aspergillus spp. for the prevention of aflatoxin contamination of maize. Dr. T. Tanaka's duty was to improve the simplified mini-column analysis methods of maize kernel contaminated by aflatoxin. Dr. Micho Kosaki's duty was to guide and advise for the newly developed techniques for the MQIRC. They finished their duties and went back to Japan on October 19, November 27 and December 17, 1990 respectively. (refer to annex I)

II. Counterpart training

In the 1990 Japanese fiscal year, four counterparts have been selected as staff for training. Two of them finished their duties and came back to Thailand. They are Mrs. Prisnar Siriacha, Mrs. Kanjana Bhudhasamai, Mr. Pimol Wuttisin and Mrs. Boonluck Seetanun, respectively.

Mrs. Prisnar Siriacha, the counterpart for Microbe Section, stayed at the National Food Research Institute, M.A.F.F., and Tokyo University of Agriculture, for 30 days from June 30 to July 29, 1990.

Mrs. Kanjana Bhudhasamai, the counterpart for microbe studies, was staying at the National Food Research Institute, M.A.F.F., for 92 days from October 30, 1989 to January 19, 1990.

Mr. Pimol Wuttisin, the counterpart for post-harvest research is going to visit at the National Grassland Research Institute, M.A.F.F., for three months, from January 28 to April 28, 1990.

Mrs. Boonluck Seetanun, the counterpart for administration, she is going to a study tour on agricultural administration and management concerning research work at several institutes in Japan for three weeks in March 1991. (refer to Annex I)

III. Equipment and Facilities

In the 1989 Japanese fiscal year (from April 1, 1989 to March 31, 1990), the total budget for technical equipments was 57,785,000 Yen (Baht 10,902,000). Namely, the 5,226,310 Yen (Baht 986,096) was used for the accompanied equipments with the experts, the amount of 5,700,000 Yen (Baht 1,075,472) for the equipments arranged by JICA Head Quarter and the amount of 46,645,167 yen (Baht 8,800,975) for the equipments purchased in local. The list of equipments is attached to this paper.

The amount of 5,353,000 Yen (Baht 1,010,000) was supplied for the facility constructions, which are, the storage

building and extension of Annex I building, completed in October 18, 1991.

The equipments, which will be provided in the 1990 Japanese fiscal year (from April 1, 1990 to March 31, 1991), are in process of purchasing. It would estimate the total cost at 55,000,000 yen (Baht 10,377,358) (refer to Annex III)

IV. Project activities

1. Mr. S. Ueda, Mr. T. Nibe, Mr. M. Harada, Mr. K. Arai and Thai counterparts concerned participated in the DOA Annual Conference held in Pattaya from April 23 to April 26, 1991. Mr. T. Nibe gave a presentation titled "Study of Harvesting Method, Harvesting Time and Storage duration on Aflatoxin Occurrence in Corn". Mr. M. Harada has reported as titled of "Post-Harvest Research on Aflatoxin Contamination in Maize". Mr. K. Arai gave a presentation titled "Relation between Water Activity (aw) and Humidity Equilibrium Moisture Content of Maize and Growth of A. flavus".

2. Mr. T. Nibe and Thai counterparts attended to the National Corn and Sorghum Reporting Session held at Chumphon on August 14, 1990. Mr. Prasop Debyasuvarn gave a presentation titled "Outline of the Maize Quality Improvement Research Centre Project". Mr. T. Nibe has reported as titled "Effects of difference Harvest Methods, Moisture contains and Storage, on Aflatoxin Contamination in maize".

3. The third field trip and spot discussion of the four sections were held at Phra Phutthabat field Crops Experiment Station on January 8, 1991.

4. Research Activities
   A series of experiments has been carried out under the Tentative Implementation Program, which was confirmed at the Joint Committee Meeting on April 19, 1990. The main subjects impiemented in three sections are as follows :

i) Agronomy Section
Total twelve research subjects were proposed in the agronomy section in 1990. Field experiments were started from April 16th, 1990 and there are some more materials in the field and storage. All the work will be completed in mid of March 1991. General condition for maize cropping season was not favorable due to the poor rainfall distribution after mid of June to September.
Over one thousand samples of maize and soil were taken this year for aflatoxin analysis, fungi test and chemical properties.
Harvesting methods and storage was observed a tendency that with husk treatments lowered the level of aflatoxin contamination than conventional without husk as the result of

last two years experience. The same treatments on farm scale trials, in general, showed similar result. However, visual appearance of ear quality by fungi infection which occurred by high temperature and dew condensation was raised as a problem to be improved.

2) Post-Harvest Section

Research work of this section can be catergorized into four. For corn sheller improvement, three types of pro-type corn shellers are tested to select practical type. And it was proved that ear maize stored with husk can be selled by corn sheller with rasp-bar cylinder. About moisture meter, standardization of the oven method and calibration test of moisture meters were under investigation to get better correlation among measured values. Ear maize moisture meter was newly designed and calibrating test is under process. For chemical treatment, sulfurdioxide treatment was conducted to fumigate from 0.5% to 0.125% at one time or at three days intervals. Ammonia treatment was also planned with urea decomposed by soybean. And for storage and drying, effect of modifying farmers' storage are examined to improve farmers' storage. Allowable duration to postpone drying ear maize are investigated and data for forced air drying are collected in the same experiment. And solar house drying was examined to utilize multi-layer system to increase drying capacity. Last year 288 samples was sent to microbe section for analysis of aflatoxin or of Aspergillus flavus infection.

3) Microbe Section

This section has close relations with the Agronomy and Post-Harvest researches. In 1990 crop season, 211 of maize samples for aflatoxin qualitation and quantititation 174 of maize samples and 252 of soil samples for microbiological studies were received from the Agronomy Section. The Post-Harvest Section sent us 288 of maize samples for aflatoxin analysis, both drying and chemical treatments.

The Microbe Section carried out their six main subjects, viz. physiological and ecological study of A. flavus and analytical study of aflatoxin of maize. About 640 of samples in the field, drying and storing test were analyzed on aflatoxin and more than 700 of maize samples were used for microbiological studies. Both the microbiological techniques and the analytical method of aflatoxin by means of mini-column method were transferred to the junior scientist in the section.

Annex I

Experts	1st Year Dec.1986 ~ Dec. 1987	2nd Year Dec.1987 ~ Dec. 1988	3rd Year Dec.1988 ~ Dec. 1989	4th Year Dec.1989 ~ Dec. 1990	5th Year Dec.1990 ~ Dec. 1991
Team leader					
Dr. Taketoshi YOSHIYAMA				(Jul.21.'87 - Dec.20.'89)	
Mr. Sei-ichi UEDA					
Long-term experts					
Mr. T. SEINO (Coordinator)		(May 20.'87 - Dec.14.'91)			
Mr. M. KOBAYASHI (Post-harvest)				(May 20.'87 - Nov.19.'89)	
Mr. M. HARADA (Post-harvest)		(Dec.8.'87 - Dec.14.'91)			
Mr. T. NIBE (Agronomy)			(Jun.30.'87 - Dec.14.'91)		
Mr. K. ARAI (Microbe)			(Jul.8.'88 - Dec.14,'91)		
Short-term experts					
1987 Japanese fiscal year					
Mr. Y. IDEGUCHI (Engineer)		(1)	(Dec.15 - 26,'87)		
Mr. H. SHIMADA (Microbe)		(2)	(Mar.10 - Jun.17,'88)		
Mr. Y. TOMIOKA (Engineer)			(Mar.10 - Apr. 8,'88)		
1988 Japanese fiscal year					
Mr. N. ISHITANI (Moist. tester)			(Aug. 1 - Aug.19,'88)		
Mr. Y. AZUMA (Corn sheller)			(Jul.20 - Sep.19,'88)		
Mr. M. KAMO (Ammonia treatment)			(Jul.20 - Sep.19,'88)		
Dr. O. TSURUTA (Microbe)			(Aug.19 - Oct.27,'88)		
1989 Japanese fiscal year					
Mr. N. ISHITANI (Moist. tester)				(Aug. 1 - Sep. 9,'89)	
Mr. M. KAMO (Ammonia treatment)				(Jul. 6 - Aug.24,'89)	
Mr. Y. AZUMA (Corn sheller)				(Jul. 6 - Nov.11,'89)	
Mr. K. INOUE (Drying method)				(Jul.25 - Sep.24,'89)	
Dr. O. TSURUTA (Microbe)				(Jun.16 - Aug.15,'89)	
Mr. T. GOTO (Analyze)				(Sep.14 - Dec.12,'89)	
Mr. M. TSUIKI (Similation)				(Sep.27 - Nov.26,'89)	
1990 Japanese fiscal year					
Mr. Y. AZUMA (Corn sheller)			(Jul.20-Nov. 3,'90)		
Dr. M. SAITO (Microbe)			(Aug.20-Oct.19,'90)		
Mr. A. MATSUZAKI (Drying method)			(Aug.21-Nov.18,'90)		
Dr. O. SAITO (Insect)			(Oct. 3-Dec. 3,'90)		
Dr. T. TANAKA (Analyze)			(Oct. 4-Nov.27,'90)		
Mr. M. TSUIKI (Similation)			(Nov. 6-Dec.16,'90)		
Mr. Y. SAITO (Photosynthesis)			(Nov. 6-Dec.24,'90)		
Prof. Dr. M. KOSAKI (Microbe)			(Dec. 4-Dec.17,'90)		
1991 Japanese fiscal year					

Remark : Assignment of short term experts in 1991 Japanese Fiscal Year, 3 experts will be dispatched by the J I C A.

Annex II

Training in Japan	1st Year Dec.1986 ~ Dec. 1987	2nd Year Dec.1987 ~ Dec. 1988	3rd Year Dec.1988 ~ Dec. 1989	4th Year Dec.1989 ~ Dec. 1990	5th Year Dec.1990 ~ Dec. 1991
1987 Japanese Fiscal Year					
Mr. Narongsak Senanarong (Field Crops Research Institute)	■	(Sep.28 - Oct.17)			
Mrs. Sriwai Singhagajen (Division of Agri. Engineering)	■	(Sep.28 - Oct.17)			
1988 Japanese Fiscal Year					
Ms. Arunsri Wongurai (Division of Plant Pathology and Microbiology)		■■■ (May 16 - Sep. 15)			
Mr. Sukanong Vayuparp (Field Crops Research Institute)		■■■ (Jun. 20 - Oct.21)			
Mr. Maitri Naewbanij (Division of Agri. Engineering)		■ (Oct.2 - Nov.30)			
Dr. Vijai Nopamornbodi (Administration)			■ (mar. 6 - Mar. 21)		
1989 Japanese Fiscal Year					
Mr. Suparat Kositcharoenkul (Division of Plant Pathology and Microbiology)				■■(Jan. 14-Apr.17)	
Mr. Prasop Depayasuvan (Field Crops Research Institute)			■■(Jul.10-Sep.2)		
Mr. Chaiwat Paosantadpanich (Division of Ari. Engineering)				■■■(Oct.30-Jan.28)	
Mrs. Siriporn Sindhusake (Administration)				■(Mar.5-Mar.28)	
1990 Japanese Fiscal Year					
Mrs. Prisnar Siriacha (Division of Plant Pathology and Microbiology)					■(Jun.30-Jul.29,'90)
Mrs. Kanjana Bhudhsamai (Division of Plant Pathology and Microbiology)				(Oct.15,'90-Jan.15,'91) ■■	
Mr. Pimol Wttisin (Division of Ari. Engineering)				(Jan.)&Apr.28,'91)	■■
1991 Japanese fiscal year					
Dr. Vichitr Benjasil (Field Crops Reseach Institute)					□
Mr. Pravat Tan Boon-ek (Division of Plant Pathology and Microbiology)					□
Mr. Nitat Taewbani (Division of Ari. Engineering)					□□

■ = attended □ = scheduled

Annex III. Equipment & local cost

Equipment (budget)	1st Year Dec.1986 ~ Dec. 1987	2nd Year Dec.1987 ~ Dec. 1988	3rd Year Dec.1988 ~ Dec. 1989	4th Year Dec.1989 ~ Dec. 1990	5th Year Dec.1990 ~ Dec. 1991
1987 Japanese Fiscal Year (General)	5,100,000 ¥				
1988 Japanese Fiscal Year					
1) General					
2) Agronomy	7,603,000 ¥				
3) Post-Harvest	12,435,000 ¥				
4) Microbe	6,302,000 ¥				
1988 Japanese Fiscal Year					
1) General		1,360,000 ¥			
2) Agronomy		12,670,000 ¥			
3) Post-Harvest		13,140,000 ¥			
4) Microbe		16,100,000 ¥			
1989 Japanese Fiscal Year					
1) General			4,382,000 ¥		
2) Agronomy			16,543,000 ¥		
3) Post-Harvest			20,662,000 ¥		
4) Microbe			16,198,000 ¥		
1990 Japanese fiscal year					
1) General				8,384,000 ¥	
2) Agronomy				26,314,000 ¥	
3) Post-Harvest				7,218,000 ¥	
4) Microbe				3,031,000 ¥	
1991 Japanese fiscal year					
1) General					
2) Agronomy					
3) Post-Harvest					
4) Microbe					
	31,530,000 ¥	42,500,000 ¥	57,785,000 ¥	53,336,000 ¥	15,000,000 ¥

Local cost borne by Japan in Japanese fiscal year 1987, Baht 3,060,000.- for repairing water reservoir, in 1988 Baht 484,500.- for modification of the laboratory at Prabuddhabat Field Crops Experiment Station and in 1989 Baht 1,014,139 for roof expansion and storage building was provided.

2）栽培部門

Experiment Summary of Agronomy Section in Maize Quality Improvement Research Center Project (MQIRC Project, DOA/JICA) for Three Years from 1988 to 1990 Cropping Year

AG/I. Varietal Comparison of Maize Kernel Moisture and Its Variation According to Different Time of Harvesting

Research Implementation Plan:
1. Analysis of Contamination Factors
(1) Correlation between cultural practices and aflatoxin contamination
Code No.I-1-(1)-A,G(1988-1990)

Research Member:
Narongsak SENANARONG, Prasob DEBYASUVARN, Sukapong WAYUPAP, Weerawat NILRATTANAKOON, Teruhiko NIBE

Summary:
The study is to describe kernel moisture feature at different harvesting time on popular Thai maize varieties. This will contribute the basic information to research work and aflatoxin prevention on kernel moisture condition and fungi infection and aflatoxin contamination of Thai maize.

Five popular and newly developed Thai maize varieties, Suwan 1(3 years), Suwan 2(2 years), KU2602(2 years), Suwan 3(2 years) and Nakhon Sawan 1(1 year), were applied for the study in last three years. Kernel moisture content(MC) was measured by the single kernel moisture meter of Shizuoka Seiki Co. LTD..

Moisture feature of five varieties as an average and a range of MC at from 35 days to 64 days after 50% silking were obtained. Varietal differences were not significant except Suwan 2.
An indication manual of grain moisture content at harvest will be prepared in the project period.

Achievement: 70%

Problem Remained:
The moisture in the study was measured by a single moisture meter which is not popularly used, the conversion of obtained data to the figure of the popularly used moisture meter in Thailand is required.
The indication manual of grain moisture content at possible harvesting day is to be completed.

AG/II.Study on The Relation Between Environmental Condition and Aflatoxin Incidence in Maize

Research Implementation Plan:
1. Analysis of Contamination Factors
(1) Correlation between cultural practices and aflatoxin contamination
Code No.I-1-(1)-B,G&J(b)(1988-1992)
Related Code No.III-1-(1)-A,B

Research Member:
Narongsak SENANARONG, Prasob DEBYASUVARN, Sukapong WAYUPAP, Weerawat NIL-RATTANAKOON, Arunsri WONGRAI, Teruhiko NIBE, Katsusuke ARAI

Summary:
Effect of environmental condition on maize cultivation to aflatoxin occurrence and productivity is an important to determine the appropriate time of planting and harvesting for farmers to produce good quality maize with profitable economical return.

Planting was practiced eleven times by two weeks interval from mid of April until early September. And a rain-fed condition and an irrigated condition which insure a minimum water supply weekly at the level of the last ten years average were applied on the study. Harvest were carried out at 105, 115 and 125 days after planting in 1988 and 95, 105 and 115 days after planting in 1989 and 1990. Aflatoxin contamination were observed at harvest and 2, 4, 6(1988 only) and 8 weeks after harvest.

Annual yield average were 514.7, 228.4 and 536.4kg/rai on irrigated plots and 109.2, 127.6 and 318.8kg/rai on rainfed plots in 1988, 1989 and 1990 respectively. Highest yield at planting time were 887.3kg/rai on April 28 planting in 1988, 358.9kg/rai on May 26 planting in 1989 and 808.6kg/rai on May 26 planting in 1990 on irrigated plots, and 834.9kg on April 28 planting in 1988, 218.9kg on June 9 planting in 1989 and 551.2kg on May 26 planting in 1990.
None of aflatoxin was found at harvest. Maximum contamination levels by cropping year were 771ppb in 1988, 2259ppb in 1989 and 2478ppb in 1990. Maize grown under the irrigated condition was lower contamination level than it of the rainfed across planting time and sampling. Average aflatoxin level in 8 weeks after harvest by harvest were 240.7ppb, 90ppb and 36.8ppb from irrigated condition and 148.5ppb, 44.8ppb and 20.5ppb from rainfed when maize harvested by 95 days, 105 days and 115 days after planting. Aflatoxin contamination by planting month in average across samples were in ppb. 199.7, 178.0, 197.2, 86.7, 7.6 and 10.0 on the maize from irrigated condition and 29.1, 113.4, 113.1, 58.9, 58.3 and 38.4 from rainfed on April, May, June, July, August and September respectively.

Achievement: 70%

Problem Remained:
The task for simulation model for maize production and quality is carry on since 1989 to investigate the Thai maize production pattern more precisely in this experiment, however it will take longer time to collect a necessary data to complete the work. Technical cooperation in order to accomplish this work has been requested to the Japanese government for continuing after the project termination.

AG/III. Effects of Different Harvest Methods, Moisture and Storage Periods on Aflatoxin Contamination in Maize

Research Implementation Plan:
1. Analysis of Contamination Factors
(1) Correlation between cultural practices and aflatoxin contamination
Code No.I-1-(1)-H, G(1988-1990)
Related Code No.III-1-(3)

Research Member:
Narongsak SENANARONG, Prasob DEBYASUVARN, Sukapong WAYUPAP, Weerawat NIL-RATTANAKOON, Arunsri WONGRAI, Teruhiko NIBE, Katsusuke ARAI

Summary:
Harvesting method was considered as a factor to be investigated the relation with aflatoxin occurrence.

Harvest with husk and a conventional harvest which removed husk were practiced and kept in the storage for eight weeks. Harvest was practiced at 95 days , 105 days and 115 days after planting. Grain moisture content and aflatoxin contamination were monitored at harvest and during the storage.

Grain moisture content during the storage were not significant difference and the maximum difference between with husk and without was less than 3%. Aflatoxin contamination at harvesting time were not observed except one in 1990 at 115 days harvest. Maximum aflatoxin contamination were 1226ppb, 391.5ppb and 404ppb in 1988, 1989 and 1990 respectively. Contamination level in treatment average were decreased by 84.0%, 88.6% and 60.5% on harvest at 95 days, 105 days and 115 days when harvested and stored with husk than conventional method. Safety period, which is set under 20ppb, across three years were 4.7 weeks and 1.3 weeks on with husk and without husk at 95 days harvest, 5.3 weeks and 2.7 weeks at 105 days harvest and 6.7 weeks and 3.3 weeks at 115 days harvest.
Harvest and store with husk lowered the level of aflatoxin contamination and elongate the period of safe in the store.

Achievement:100%

Problem Remained:
The study as a factor finding is completed. The result obtained that harvest and stored with husk showed lower aflatoxin contamination was confirmed as phenomenon, however the reason why a with husk harvest lowered the level of contamination was not found yet.
On-farm trial to approve the result at farmer's scale has started in 1990 cropping year.

TABLE 1 Changes infection and contamination by fungus in maize during storing in Crib - A

Storage time	Code	A. flavus		A. niger		F.moniliforme		P.funiculosum		other fungI		Note
		no	wash	no	wash	no	wash	no	wash	no	wash	
start	+H	98	4	27	1	-	5	-	5	1	3	Botryodiplodia sp.
	-H	47	1	99	3	-	11	5	8	2	2	Botryodiplodia sp. Rhizopus sp.
1 week	+H											[no sample]
	-H											
2 weeks	+H	46	-	100	4	2	-	-	6	4	10	Rhizopus sp. Botryodiplodia sp.
	-H	6	30	30	24	-	14	-	38	8	6	Curvularia sp. A.Terreus Rhizopus sp. Botryodiplodia sp.
3 weeks	+H	58	2	100	2	-	-	-	12	-	14	Rhizopus sp. Botryodiplodia sp. Curvularia sp.
	-H	58	8	90	12	-	9	-	40	2	6	Botryodiplodia sp. Rhizopus sp. p.citrinum
4 weeks	+H	48	-	100	2	-	14	50	40	-	6	Rhizopus sp. Botryodiplodia sp.Curvularia sp.
	-H	66	8	100	4	-	18	66	66	-	4	Rhizopus sp. A.terreus P.citrinum

Storage time	Code	A.flavus		A.niger		F.moniliforme		P.funiculosum		other fungi		NOTE
		no	wash	no	wash	no	wash	no	wash	no	wash	
5 weeks	+N	98	2	92	-	-	-	10	26	50	10	Botryodipoldia sp. Rhizopus sp. P.sp.
	-N	78	-	100	4	-	8	4	28	30	12	Botryodiplodia sp. P.sp.
6 weeks	+N	100	-	88	-	-	4	10	13	8	10	Botryodiplodia sp. Yeast
	-N	100	2	98	2	-	16	24	38	10	10	Botryodipoldia sp.
7 weeks	+N	-	-	100	-	-	-	32	18	6	12	Botryodiplodia sp. P.citrinum
	-N	100	6	94	-	-	-	14	18	8	12	Botryodiplodia sp. Bacteria Yeast P. Citrinum
8 weeks	+N	42	-	100	-	-	4	10	24	10	10	Botryodipoldia sp. Rhizopus sp.
	-N	30	4	100	-	-	6	10	36	10	18	Botryodiplodia sp. F.sp.
9 weeks	+N	44	-	100	-	-	-	18	12	10	10	Botryodiplodia sp.
	-N	28	6	100	4	-	-	24	20	4	12	Botryodiplodia sp. Rhizopus sp. P. citrinum
10weeks	+N											[no sample]
	-N											

TABLE 2 Changes infection and contamination by fungus in maize during storing in Crib - B

Storage time	Code	A flavus		A niger		F.moniliforme		P.funiculosum		other fungi		Note
		no	wash	no	wash	no	wash	no	wash	no	wash	
start	+B	77	-	29	-	17	15	18	--	-	-	Bacteria Neurospora sp.
	-B	60	-	56	-	3	12	49	1	1	4	Alternaria sp. A.terreus bacteria Neurospora Rhizopus sp. Botryodiplodia sp.
1 week	+B	54	4	100	2	-	12	2	8	4	4	Rhizopus sp. Botryodiplodia sp.
	-B	16	10	98	4	-	24	16	10	4	16	Curvularia sp. A.terreus Rhizopus sp. Botryodiplodia sp.
2 weeks	+B	70	8	74	10	-	24	12	40	10	12	P.citrinum Botryodiplodia sp. Rhizopus sp. Curvularia sp.
	-B	70	4	100	6	-	24	4	54	6	10	Botryodiplodia sp. Curvularia sp. A.terreus
3 weeks	+B	62	2	100	-	-	4	40	16	-	28	Rhizopus sp. Curvularia sp. A.terreus A.sp.
	-B	72	-	100	2	-	36	32	50	-	8	Rhizopus sp. Curvularia sp. A.terreus
4 weeks	+B	24	2	100	-	-	-	46	32	-	22	Botryodiplodia sp. A.terreus A.sp.
	-B	12	-	100	2	-	16	50	26	2	24	Curvularia sp. Botryodiplodia sp. A.terreus P.citrinum

Storage time	Code	A. flavus		A. niger		F.moniliforme		P.funicilosum		other fungi		Note
		no	wash	no	wash	no	wash	no	wash	no	wash	
5 weeks	+H	2	4	100	6	-	4	52	22	6	12	Botryodiplodia sp.
	-H	60	2	100	8	-	14	66	64	2	12	Botryodiplodia sp. A.terreus A.glaucus
6 weeks	+H	4	-	100	2	-	-	34	14	10	10	Botryodiplodia sp.
	-H	4	-	100	4	-	8	32	38	8	10	Botryodiplodia sp. P.citrinum
7 weeks	+H	4	2	100	2	-	-	-	18	78	12	Botryodiplodia sp. P.sp. Rhizopus sp. P.citrinum
	-H	12	2	100	8	-	8	-	32	102	10	P.sp. Rhizopus sp. Botryodiplodia sp.
8 weeks	+H	24	2	100	8	-	2	-	4	26	10	Botryodiplodia sp. P.sp.
	-H	10	-	100	14	-	12	-	46	38	24	Rhizopus sp. P.citrinum Botryodiplodia sp. P.sp. yeast A.terreus A.glaucus
9 weeks	+H	-	-	100	4	-	4	-	16	34	10	Botryodiplodia sp. P.sp.
	-H	14	4	100		-	10	-	22	24	12	Botryodiplodia sp. P.sp., Bacteria
10weeks	+H	78	6	98	-	-	26	-	16	30	28	A.sp. Alternaria sp. Rhizopus sp. P.sp. Botryodiplodia sp. A.terreus
	-H	64	14	100	4	-	20	-	26	44	12	P. citrinum Rhizopus sp. P.sp. Botryodiplodia sp. A.terreus

TABLE 3 Changes infection and contamination by fungus in maize during storing in Crib-C

Storage Line	Code	A.flavus		A.niger		F.moniliforme		P.funiculosum		other fungi		Note
		no	wash	no	wash	no	wash	no	wash	no	wash	
Start	+N	28	-	100	16	-	26	3	6	-	-	Rhizopus sp
	-N	94	8	76	4	-	16	4	6	8	4	Rhizopus sp. Botryodiplodia sp.
1 week	+N	56	-	86	2	-	8	14	10	10	10	Botryodiplodia sp. Rhizopus sp.
	-N	98	6	98	4	-	36	-	14	6	6	Botryodiplodia sp. Rhizopus sp.
2 weeks	+N	70	-	98	-	-	-	-	10	10	10	Botryodiplodia sp. Rhizopus sp.
	-N	92	8	100	2	4	36	18	18	6	20	P.citrinum Rhizopus sp. Botryodiplodia sp.
3 weeks	+N	68		100	-	-	10	32	32	2	10	Botryodiplodia sp. Rhizopus sp., A.glaucus A.terreus
	-N	46	4	100	-	-	40	32	28	-	6	Botryodiplodia sp. Curvularia sp.
4 weeks	+N	98	-	84	-	-	2	16	30	10	10	Botryodiplodia sp.
	-N	86	-	100	2	-	16	24	26	12	10	Botryodiplodia sp. A.terreus

Storage Line	Code	A.flavus		A.niger		F.moniliforme		P.funiculosum		other fungi		Note
		no	wash	no	wash	no	wash	no	wash	no	wash	
5 weeks	+H	2	2	100	4	-	4	26	18	22	42	A.terreus Botryodiplodia sp. Rhizopus sp. P.sp. A.sp.
	-H	42	28	100	6	-	8	40	18	4	10	Botryodiplodia sp. Rhizopus sp.
6 weeks	+H	62	2	100	-	-	-	-	6	28	14	A.terreus P.sp. Rhizopus sp. Botryodiplodia sp. Rhizopus sp.
	-H	32	6	100	2	-	36	-	34	88	12	P.sp Rhizopus sp. Botryodiplodia sp. Rhizopus sp.
7 weeks	+H	20	2	100	-	-	-	-	-	24	34	Rhizopus sp. P.sp. Yeast A.glaucus.A.terreus A.sp.
	-H	41	2	100	4	-	14	-	26	20	13	Botryodiplodia sp. P.sp. A.glaucus
8 weeks	+H	88	4	100	-	-	4	-	4	12	38	P.citrinum A.sp. Botryodiplodia sp. P.sp. Rhizopus sp. A.terreus
	-H	48	4	100	6	-	28	-	24	14	15	P.sp. A.terreus
9 weeks	+H	4	2	100	4	-	-	-	10	44	12	Rhizopus sp. P.sp. Botryodiplodia sp. A.terreus
	-H	8	8	100	16	-	18	-	50	40	42	P.sp. Yeast P.citrinum
10weeks	+H											[no sample]
	-H											

TABLE 4 Changes aflatoxin content in maize with and without husk during storing Crib - A ~ C,

Storage time	1st Storage (A) [Farner No.2]				2nd Storage (B) [Farner No.1]				3rd Storage (C) [Farner No.3]				NOTE
	+H		-H		+H		-H		+H		-H		
	B_1	B_2	B_1	B_2	B_1	B_2	B_1	B_2	B_1	B_2	B_1	B_2	
Start	ND		ND		ND		3	-	ND		3	-	
1 week	/	/	/	/	1	-	3	-	21	1	22	1	
2 weeks	ND		49	2	6	-	38	2	18	-	59	4	(A-H) G_1=6
3 weeks	58	4	134	7	3	-	138	12	112	9	219	18	
4 weeks	60	3	279	17	33	2	90	4	266	24	407	30	
5 weeks	140	7	909	43	72	6	149	13	73	5	304	22	
6 weeks	325	24	294	18	107	9	120	8	109	15	234	24	
7 weeks	84	6	551	36	27	-	287	23	15	-	553	34	
8 weeks	22	2	329	20	28	2	320	31	22	-	253	15	
9 weeks	63	5	254	12	337	32	524	34	476	33	499	32	
10 weeks	280	13	138	8	/	/	/	/	/	/	/	/	

/ = no sample

AG/IV. Effects of Plant Density and Nitrogen Application on Aflatoxin Contamination in Maize

Research Implementation Plan:
1. Analysis of Contamination Factors
(1) Correlation between cultural practices and aflatoxin contamination
Code No.I-1-(1)-D(1988-1990)
Related Code No.III-1-(1)-A

Research Member:
Narongsak SENANARONG, Prasob DEBYASUVARN, Sukapong WAYUPAP, Weerawat NILRATTANAKOON, Sompit MAIRIENG, Arunsri WONGRAI, Teruhiko NIBE, Katsusuke ARAI

Summary:
The study aimed to examine the effect of density and nitrogen application to aflatoxin prevention based on previous reports and some recommendation.

Three density levels(D1:4266, D2:8533 and D3:12266 plants/rai) and four nitrogen levels(N1:0, N2:10, N3:20 and N4:30kgN/rai) were applied. After harvest, maize was kept in the storage for two weeks. Samples were taken at harvest and two weeks after storage for grain moisture content and aflatoxin analysis.

Annual yield average across treatments were 788.3kg/rai in 1988, 341.1kg/rai in 1989 and 531kg/rai in 1990. Average yield by treatment factors were 467.8, 588.1 and 604.6kg/rai on D1, D2 and D3 of density and 471.4, 545.2, 572.8 and 624.7kg/rai on N1, N2, N3 and N4 of nitrogen application respectively.
Average grain moisture content at harvest by year were 28.9%, 22.9% and 22.5% in 1988, 1989 and 1990, it was varied due to harvesting time. By treatment factors across years were 25.0%, 24.9% and 24.4% on densities D1, D2 and D3, and on nitrogen applications were 24.6%, 24.8%, 28.8% and 24.8% on N1, N2, N3 and N4.
Aflatoxin contamination at harvest was observed only three samples in 1990 at low level of 4 to 5 ppb. Highest contamination at samples taken two weeks after harvest were 88ppb in 1988, 0ppb in 1989 and 33ppb in 1990. Significant tendency on aflatoxin on treatments was not recognized.

Achievement:70%

Problem Remained
The study was concluded as no significancy was observed on aflatoxin contamination, it due to the natural infestation of A.flavus which was not able to response to the treatments. Further consideration will be made on AG/VI of "Effect of Nitrogen Regarding Prevention of Aflatoxin Contamination by Inoculation Method" in focus on nitrogen application.

AG/V. Effects of Crop Rotation on Aspergillus spp. in Soil

Research Implementation Plan:
1. Analysis of Contamination Factors
(1) Correlation between cultural practices and aflatoxin contamination
Code No.I-1-(1)-C, B(1988-1990)
Related Code No.III-1-(3)

Research Member:
Narongsak SENANARONG, Prasob DEBYASUVARN, Sukapong WAYUPAP, Weerawat NILRATTANAKOON, Arunsri WONGRAI, Teruhiko NIBE, Katsusuke ARAI

Summary:
The study aimed to investigate the A.flavus population in the soil by changing the crop rotation. The effects was expected in reducing the fungus population in the field in order to lower the opportunity of infestation.

Possible crop rotations under the maize cultivation were applied as ten rotation systems on maize before and after soybean, mungbean, peanuts, sorghum and sesame. Normal land preparation by plowing and harrowing were practiced before 1st croppng, then before 2nd cropping the same practices were applied in 1988 and 1990, however in 1989 2nd crops were planted under the minimum tillage. Soil sample were taken before and after each cropping for count A.flavus populations at before plowing(1989 & 1990), before 1st cropping(1989 & 1990), after 1st cropping(1988, 1989 & 1990) and after 2nd cropping(1988, 1989 & 1990).

Some changes A.flavus population soil are observed by cropping system, however clear trend by cropping patterns and significant different were not recognized. A.flavus population on the 2nd crops planed under the minimum tillage in 1989 were showed opposite result on the changes of the population from after 1st cropping to 2nd cropping in the most patterns
Achievement:70%

Problem Remained
The study was decided to suspend by the reason that significancy on the treatments was not recognized under the field study. It mat need to consider this type of work to apply under the well control conditions.

AG/VI. Effects of Nitrogen Regarding Prevention of Aflatoxin Contamination by Inoculation Method

Research Implementation Plan:
1. Analysis of Contamination Factors
(1) Correlation between cultural practices and aflatoxin contamination
Code No.I-1-(1)-D(1989-1991)
Related Code No.III-1-(3)

Research Member:
Narongsak SENANARONG, Prasob DEBYASUVARN, Sukapong WAYUPAP, Weerawat NIL-RATTANAKOON, Sompit MAIRIENG, Arunsri WONGRAI, Teruhiko NIBE, Katsusuke ARAI

Summary:
Learning from Density X Nitrogen study, nitrogen was focused to study more precisely by using the inoculation method.

Four nitrogen levels(N0:0, N10:10, N20:20 and N30:30kgN/rai) were applied with two artificial inoculation methods which were a silk channel method(1989 & 1990) and a pin-bar method(1990), and natural inoculation(check)(1989 & 1990). Observations were carried out on infection ratio by inoculation methods and aflatoxin contamination at harvest.

Infected ear by inoculation methods were 3.9% by silk channel and 0.4% on check in 1989, and 4.5% on silk channel, 1.5% on check and 63.1% on pin-bar method. Aflatoxin contamination by treatments were not considered the results in 1989 due to the infection level by silk channel method was two low to compare on nitrogen levels. In 1990, 2369ppb, 1293ppb, 1375ppb and 129ppb on N0, N10, N20 and N30 respectively, however significancy was not examine due to the mistake of taking the sample of replications.

Achievement:70%

Problem Remained
Infection ratio by a silk channel method(less than 5%) was extremely low to compare the contamination level in 1989 and 1990. A pin-bar method was over 60% of infection in 1990, however the sampling was not arranged in replications. In 1991, the experiment was prepared for a pin-bar method with replications in order to confirm the result of 1990.

AG/VII. Identification of Maize Insects and the Type of Damage They Inflict on the Maize Kernel

Research Implementation Plan:
1. Analysis of Contamination Factors
(1) Correlation between cultural practices and aflatoxin contamination
Code No.I-1-(1)-F, B(1988-1991)
Related Code No.III-1-(1),(3)

Research Member:
Narongsak SENANARONG, Prasob DEBYASUVARN, Sukapong WAYUPAP, Weerawat NILRATTANAKOON, Amara TRISIRI, Arunsri WONGRAI, Teruhiko NIBE, Katsusuke ARAI

Summary:
Insect damage, which allows fungi penetrate into kernel, occurred during the growth period was considered as an important on the fungi infection in the field. The kind of insect giving kernel damage and the type of damage given on the kernel at growth stages were attempted to describe the background of aflatoxin problem in Thai maize production.

Insect trap for Corn Stem Borer(1989 & 1990) and a pit trap for ground insects(1990)were set and counted number of moth and insects in the one rai plot. Insects on the maize plant was observed every twice a week during the growth. A hundred of ear was taken seven to eight weeks before harvest to identify ear damage.

Percentage of ear damage by insect and unknown physical damage on the kernel were increased gradually toward the harvesting time and sound ear were decreased in contrast. At the time of harvest, 83%(1989) and 76%(1990) ear had any kind of physical damage on the kernel either by insect or by unknown cause.
Corn stem borer(Ostrinia furnacalis (Guenee)) seemed to appear in the field about twice during the maize growing period from 1990 observation.

Achievement:70%

Problem Remained
This type of work needs to continue for a long period to ensure the result. The methodology of the study has already been established.

AG/VIII. Evaluation of Insect Damage that Occurs under Field Conditions

Research Implementation Plan:
1. Analysis of Contamination Factors
(1) Correlation between cultural practices and aflatoxin contamination
Code No.I-1-(1)-F, B(1988-1991)
Related Code No.III-1-(1)

Research Member:
Narongsak SENANARONG, Prasob DEBYASUVARN, Sukapong WAYUPAP, Weerawat NILRATTANAKOON, Amara TRISIRI, Arunsri WONGRAI, Teruhiko NIBE, Katsusuke ARAI

Summary:
Insect damage occurred in the field is the problem for aflatoxin contamination by infection of A.flavus. Evaluation of a insect damage in the field is a basic information to understand the situation.

Maize was planted in one rai field with the standard practice. Small five treatment plots were divided into two for insecticide application and check. Carbofuradan granule type was applied in the whorl at four to five weeks after planting. Observations of insect appeared on the plant was counted after insecticide application. Ear condition and aflatoxin analysis were practiced at harvest.

Effect of furadan was on Corn leaf aphid(Rhopalosiphum maidis (Fitch)) and on Lady bird beetle which is predator of aphid, both appear mainly early growth period.
Ear damaged by insect were 16.6% in 1989 and 10.0% in 1990, and trace of damage by unknown cause were observed by 42.0% in 1989 and 39.4% in 1990. Sound ear were 41.3% in 1989 and 50.6% in 1990.
Aflatoxin contamination on the treatments was not significant and among the ear conditions was also not significant different.

Achievement:70%

Problem Remained
In order to obtain valuable information on this subject is required long term study due to large annual variation.

AG/IX. Relation between Kernel Type and Fungus Infection

Research Implementation Plan:
1. Analysis of Contamination Factors
(1) Correlation between cultural practices and aflatoxin contamination
Code No.I-1-(1)-A

Research Member:
Narongsak SENANARONG, Prasob DEBYASUVARN, Sukapong WAYUPAP, Weerawat NIL-RATTANAKOON, Teruhiko NIBE

Summary:
This subject was not applied due to the shortage of working time.

Achievement:*

Problem Remained

AG/X. Relation between Environmental factors and Fungus Infection

Research Implementation Plan:
1. Analysis of Contamination Factors
(1) Correlation between cultural practices and aflatoxin contamination
Code No.I-1-(1)-J b)(1989-1991)
Related Code No.III-1-(3)

Research Member:
Narongsak SENANARONG, Prasob DEBYASUVARN, Sukapong WAYUPAP, Weerawat NIL-RATTANAKOON, Arunsri WONGRAI, Teruhiko NIBE, Katsusuke ARAI

Summary:
The ecology of Aspergillus spp. in the field will give a large contribution for tackling aflatoxin problem.

Air sample in the field was taken during the maize growing period as well as storage place and farmer's facilities. Sampled fungus on the culture media were counted.

A.flavus observed in air by month were from 6.5%, 3.3%, 0.0%, 9.6% and 36.7% of sample taken on July, August, September, October and December in 1989 and 25%, 62.5% and 45.5% on August, September and October in 1990.
Weather at sampling time effect A.flavus presence in the air, 15.8% of sample in fine day, 5.3% in cloudy day and 0.0% in rainy day were found the fungus in 1989 and 45.5%, 70.0% and 0.0% in fine, cloudy and partly cloudy day in 1990.
Maize storage places at the station and farmer's were rather higher than in the field as 60% and the place shelling were carried on were 27.3% in 1989.

Achievement:70%

Problem Remained
This is the part of the study on A.flavus infection route. It is preferable to continue some more to complete data accumulation.

AG/XI.Monitoring Aflatoxin Occurrence in The Major Maize Production Areas

Research Implementation Plan:
1. Analysis of Contamination Factors
(1) Correlation between cultural practices and aflatoxin contamination
Code No.I-1-(1)-J(1989)
Related Code No.III-1-(1)-A

Research Member:
Narongsak SENANARONG, Prasob DEBYASUVARN, Sukapong WAYUPAP, Weerawat NILRATTANAKOON, Arunsri WONGRAI, Teruhiko NIBE, Katsusuke ARAI

Summary:
Aflatoxin problem occurred at major maize production areas in Thailand was attempted to monitor by collecting the sample of maize.

Ear sample for aflatoxin analysis from five provinces were collected through the field crop research center and stations.
Total 42 sample from Loei, Petchabun, Nakhon Ratchasima, Nakhon Sawan, Lop Buri provinces was sent to the station to proceed for aflatoxin analysis.
Aflatoxin contamination was observed at 9.4% of sample, however the level of contamination was less than 10ppb. Sample infected by A.flavus was 42.1% and maximum infection was 98% of plated 100 kernels. It was thought that treatment after sampled in the respective place may happen to be different and the time after sampling also differed.

Achievement:*

Problem Remained
We had faced a difficulty of collecting the sample on time and with proper treatment. It is necessary to establish the system to carry out this subject. Therefore the subject was suspended in this year.

AG/XII. Large Scale Practices on Concerning Harvest Methods and Aflatoxin Occurrence in Maize

Research Implementation Plan:
3. Countermeasure of Aflatoxin Prevention on Agronomy
(1) Improvement of Cultural Practices
Code No.I-3-(1)(1990-1991)
Related Code No.II-3-(2)-A,III-1-(3)

Research Member:
Narongsak SENANARONG, Prasob DEBYASUVARN, Sukapong WAYUPAP, Weerawat NIL-RATTANAKOON, Arunsri WONGRAI, Nitat TANGPINITKUL, Teruhiko NIBE, Katsusuke ARAI, Mitsuhisa HARADA

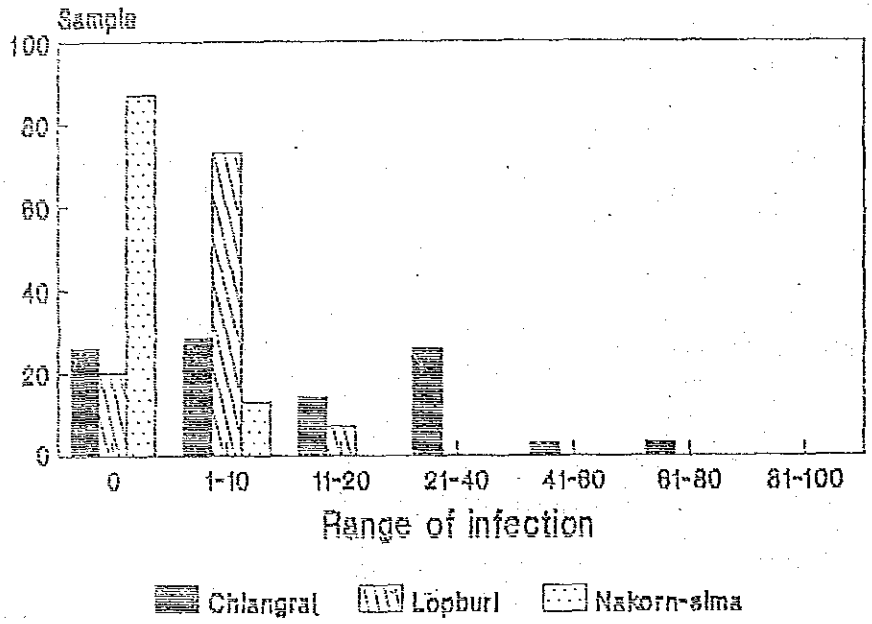
Summary:
This study is from the confirmed result of harvest method of "III. Effect of Different Harvest Method, Moisture Condition and Aflatoxin Incidence in Maize" to step up for establishing the recommended technology for farmers to control aflatoxin at farm level.

Farms around the station were selected at three locations and applied two harvesting methods, with husk and without husk, then proceeded to keep in the farmer's storage for eight weeks. Volume of storage in the three locations were 8.7, 4.8 and 4.5tons on with husk and 8.7, 3.9 and 3.03 tons on without husk at Farm1, Farm2 and Farm3 respectively.
Observations of grain moisture content, fungi infection, aflatoxin contamination and air temperature in the bulk were carried out. And also some consideration of socio-economical information was taken into consideration. Shelling test with husk was carried out by Post-harvest section of the project.

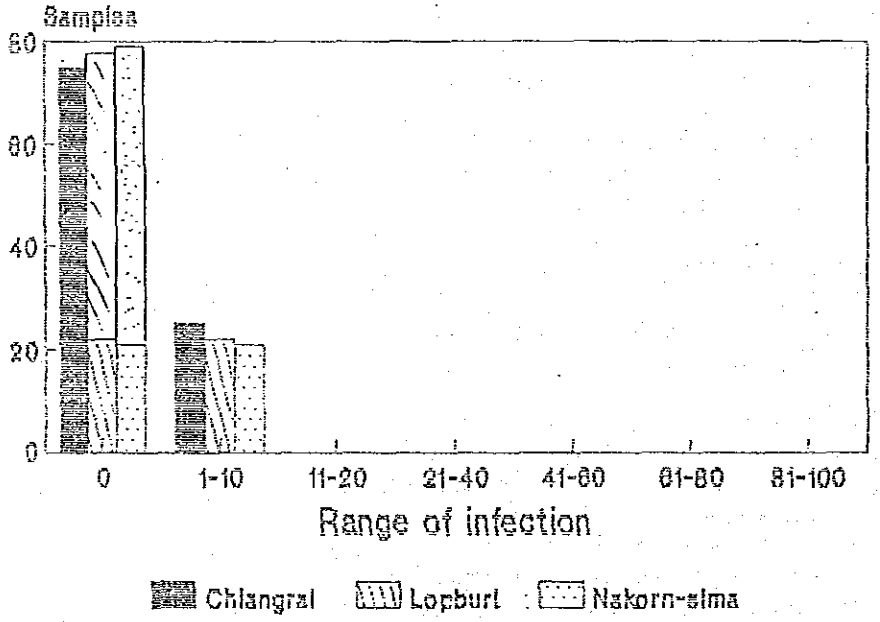
Grain moisture content of with and without husk across three location were almost parallel by within 3% difference. Average aflatoxin contamination at three location during the experiment period were 66.5, 103.2 and 119.9ppb on with husk and 179.9, 294.3 and 273.3ppb on without husk at Farm1, Farm2 and Farm3 respectively. Ratio of decreased contamination by applying with husk practice from the average were 63.0% at Farm1, 64.9% at Farm2 and 56.1% at Farm3. Air temperature in the storage bulk were depend on the size of bulk that the highest was observed as high as 30 degree C.in maximum at Farm1 and the lowest was at Farm2 around 37 degree C.. Maximum temperature level was observed within the first two weeks then gradually decreased. Visual quality of kernel was affected by Botryodiplodia spp. which changed the color of kernel pericarp to blackish and endosperms to greenish. This phenomenon was thought that its infection had been done in the field then favorable condition such as high temperature and high humidity in the bulk has accelerated it propagation.

Achievement:70%
Problem Remained
To accomplish this work for the recommended technology, the problem occurred of blackish kernel due to Botryodiplodia infection is to be solved by means of avoid extremely high temperature in the storage bulk. The plan was made for a improved storage structure to decrease air temperature, however it is depend on the fund applied to JICA for building the improved storage and purchasing sample maize.

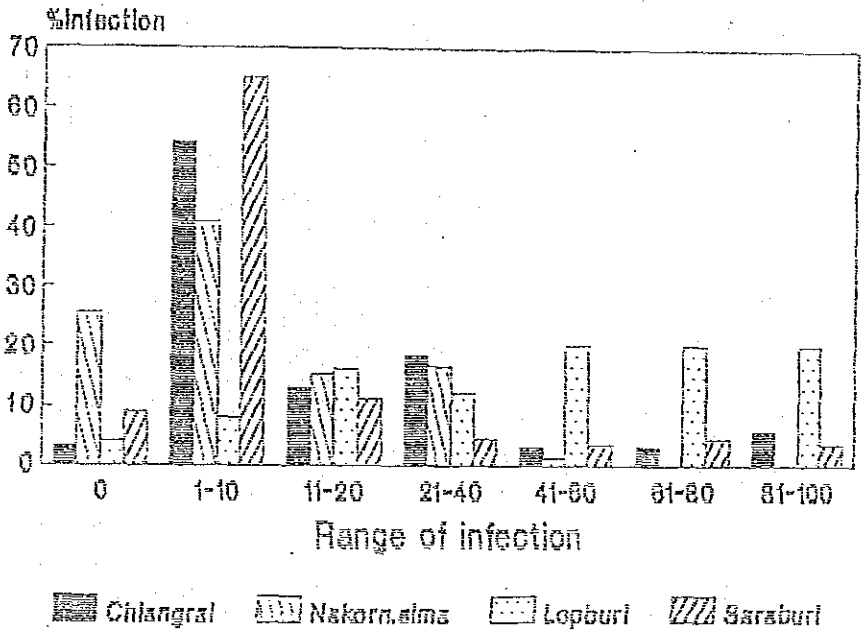
Sample infected with A.flavus
in farmer's storage



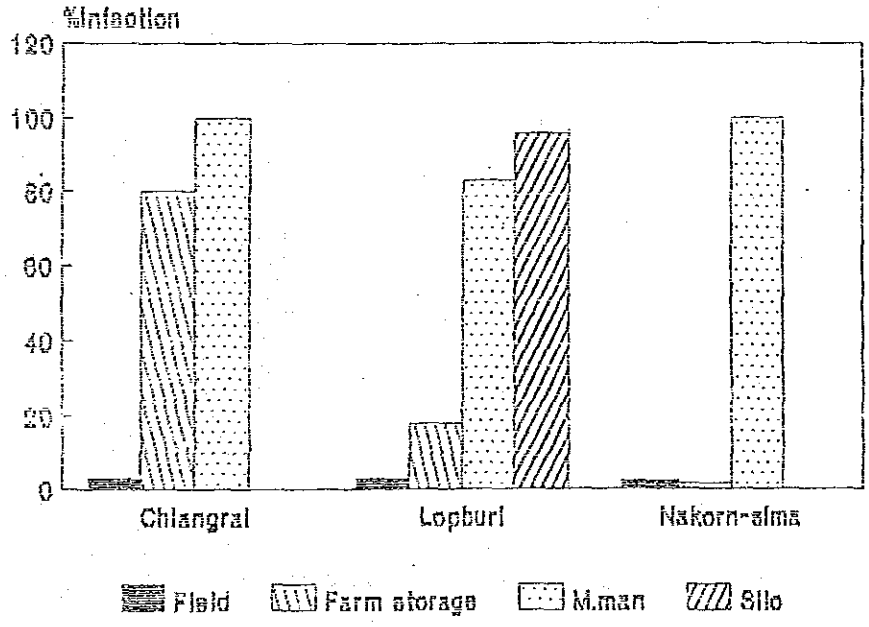
Sample infected with A.flavus
in farmer's field



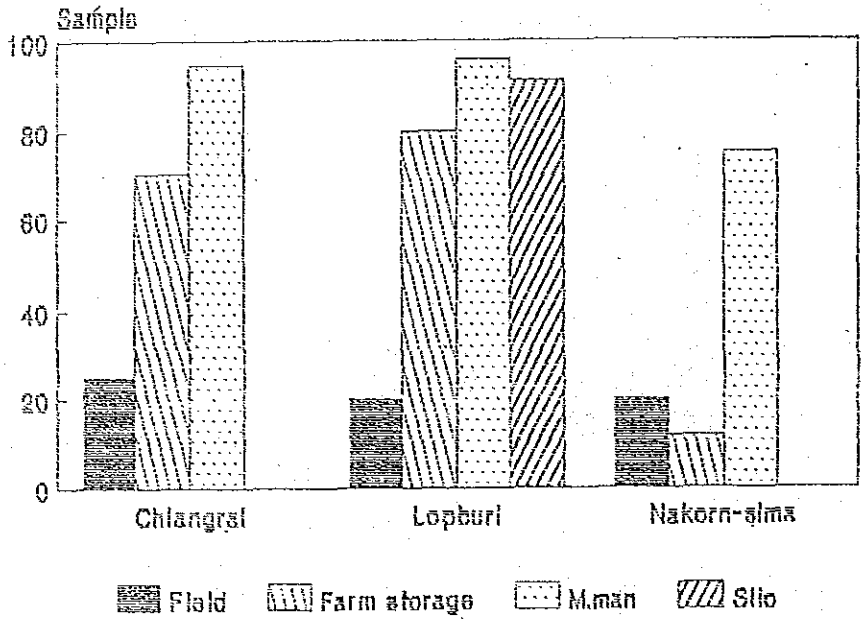
A.flavus infected maize
in middleman and silo



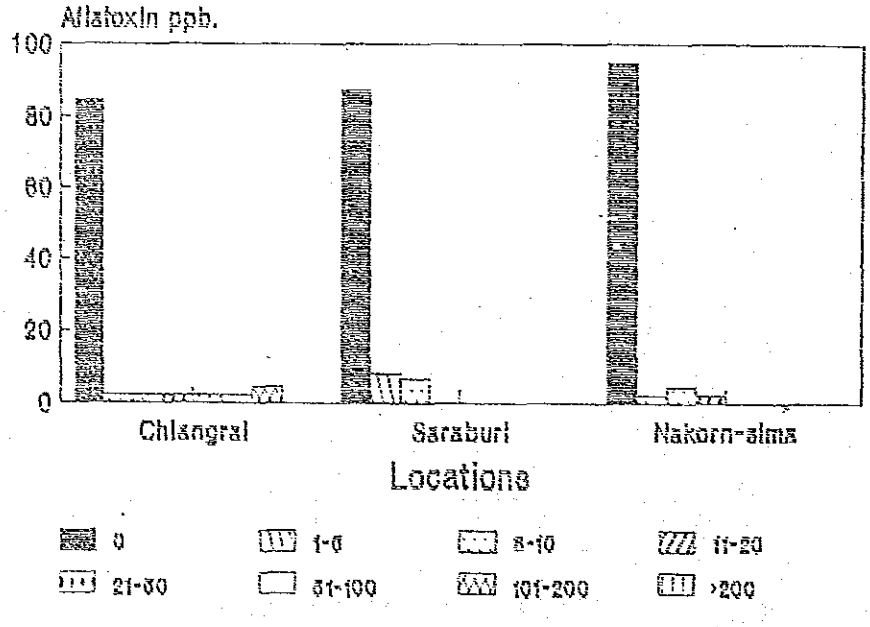
Percent infection kernel
A.flavus in maize



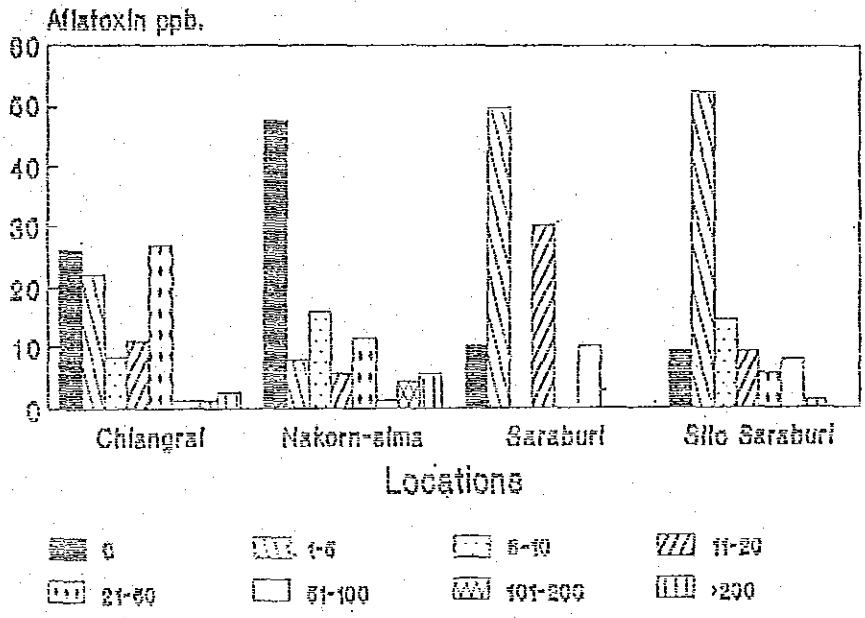
Percent infection sample
A.flavus in maize



Aflatoxin contamination
in field



Aflatoxin contamination
in middleman & silo



AG/XIII. Basic Agronomical Study for Developing the Simulation Model of Maize Productivity and Its Quality

Research Implementation Plan:
1. Analysis of Contamination Factors
(1) Correlation between cultural practices and aflatoxin contamination
Code No.I-1-(1)-J(b)

Research Member:
Narongsak SENANARONG, Prasob DEBYASUVARN, Sukapong WAYUPAP, Weerawat NIL-RATTANAKOON, Teruhiko NIBE

Summary:
In relation with the subject of "II. Study on the Relation between Environmental Condition and Aflatoxin Incidence in Maize", precise study for Thai maize production and its quality was required by the means of a simulation model. This subject is a basic information for the model. The model was modified by Mr. M. Tsuiki in 1989 from the original which was made for a whole crop maize production in Japan to grain maize production in Thailand.

Five planting times and two water conditions in the above experiment and observation of dry matter according to the plant growth were taken.
Dry matter accumulation by the part of the plant during the growth period on each planting and leaf area index were collected in 1990 cropping year.
The summary of the study was reported by Mr. M.Tsuiki.
In the study, a training of measurement of photosynthesis was carried out by Mr.Y Saito in 1990 to proceed the data collection in the further study.

Dry matter accumulation and leaf area of maize plant at four time of planting under irrigated and rainfed conditions was started in 1990 in order to input the data for simulation model. Summary data was arranged for the model.

Achievement:60%

Problem Remained
This subject is to be continued four to five years until enough data for the model is accumulated. The meteorological instruments were not yet completely set up and functioning for data collection.
The request of a five year technical cooperation for this subject was prepared by the Department and submitted to DTEC through official procedure.

3) 乾燥調製部門

Experiment Summary of Post-Harvest section in Maize Quality Research Center Project DOA/JICA from 1987 to 1990

Survey on the Present Situation of Farmers' and Middlemen's Post-Harvest Practice Regarding Maize in Thailand (1987)

Research Implementation Plan
1.Analysis of contaminating factors
(2)Correlation between post-harvest storing/processing and aflatoxin contamination
Code No. II-1-(2)-A

Chaiwat Paosantadpanich, Pimon Wuttisin,Arunsri Wongurai
Sriwai Singhagajen, Makoto Kobayashi, Katsusuke Arai

Summary

The main objectives of this survey are (1) to collect about farmers and merchants in in main production area, (2) to identify and clarify problems in post-harvest practice and (3) to investigate factors to reduce aflatoxin contamination.
142 farmers were selected interviewed by recomendation of agricultural extention offices from four main production area, Nakhorn Sawan, Petchaboon, Loei and Nakhorn Ratchasima Province. 32 middlemen were also surveyed in the same manner. Samples from these farmers and middlemen were analysed by the Microbe Section in our center.
1) Surveyed areas were classified into three categories, no-2nd-crop area, 2-times-cropping area, 2nd-crop-maize area.
2) 11.7% of farmers have drying floor and 16.1% of farmers dry their maize in field. No farmer dry their dry maize in no-2nd-crop area, and more farmers in 2nd-crop-maize area dry maize than in 2-times-crop area.
3) Farmers storage can be divided into five types, elevated, non-elevated floor or grounded corn cribs and under house storage with elevated or non-elevated floor. And in no-2nd-crop area all farmers store maize for 51.4 days in average, and in other aera 47.2% of farmers store maize average 17 days.
4) Only 4.3% of farmers own their corn shellers and most of farmers use middlemen's sheller.
5) 45 samples from farmers and 34 samples from middlemen were analysed and 21 samples were contaminated by aflatoxin. Most of the contaminated samples are from 1st crop maize or 1st crop maize area.
6) Crackage by corn sheller is 0.33±o.34%.
7) One sample from four collected in the field was already infected by A. flavus and 43% of samples were already infected within 10 days from harvest.

Achievement : 90%

Study on the Relationship between Damage on Kernel, Kernel Moisture Content and Aflatoxin Contamination (1989-1990)

Research Implementation Plan
1.Analysis of contamination factors
(2)Correlation between post-harvest storing/processing and aflatoxin contamination
Code No. II-1-(2)-B

Nitat Tangpinijkul,Arunsri Wongurai, Sriwai Singhagajen
Makoto Kobayashi, Mitsuhisa Harada, Katsusuke Arai

Summary
This experiment was conducted to evaluate effect of damage on kernel or impurity to aflatoxin contamination during storage period.
In 1989 manually shelled ear maize sample were mixe with damaged kernel (3%, 6%) or mixed with impurity (ground cob 3%) and stored under humid condition. Aflatoxin contamination was observrd from 7th day and more in 14th day. At moisture content of 22%, samples were most highly contaminated. At 30%, Samples were affected by mold severly but seems to be less contaminated.
In 1990, this experiment was conducted with innoculated samples again.

Achievement : 80%

Problems Remained
Effect of scratch on seed coat is not evaluated.

Estimation on Increase of Damaged Kernel Ratio During Handling (1989)

Research Implementation Plan
1.Analysis of contamination factors
(2)Correlation between post-harvrst storing/processing and aflatoxin contamination
Code No. Ⅱ-1-(2)-B-c & Ⅱ-1-(2)-C-a

Nitat Tangpinijkul, Sriwai Singhagajen, Makoto Kobayashi

Summary
To investigate effect of pre-storage quality of ear maize on aflatoxin prevention, we prepared three quality levels of ear maize, not selected, selected by farmers and by researchers. Samples were kept in gunny sacks and stored for seven days under ambient conditions.
However, selected ear maize showed higher affection rate by A. flavus. In non-selection maize, 4.2 % of ear maize were affected by A. flavus and 55.9 % of them had small damage on seed coat, while in farmers' selection; 35.4% and 87.4%, in researchers' selection; 45.1% and 88.9%, respectively. According to the observation, aflavus infected even from small scratches on seed coat.

Achievement : 80%

Problems Remained
Effect of rejecting unfavorable ear for storage to controle aflatoxin, which is the original purpose of this experiment, has not yet been evaluated.

Allowable Duration for Delay of Drying in the Post-Harvest (1989-)

Research Implementation Plan
1.Analysis of contaminating factors
(2)Correlation between post-harvest storing/processing and aflatoxin contamination
Code No. II-1-(2)-C-c

Pimol wuttisin, Arunsri wongurai, Sriwai Singhagajen
Makoto Kobayashi, Mitsuhisa Harada, Katsusuke Arai

Summary
To know the allowable delay of drying concerning aflatoxin contamination, freshly harvested ear maize was stored previously and dried with forced ambient air.
In 1989 different moisture contents of ear maize samples were stored for 0, 1, 2, 3, 5, and 7 days in a flat bed dryer and dried. Drying rate was rather high, because of the air flow rate and dry season. Aflatoxin was detected at high moisture maize but non of them exceeded safety limit of 10 ppb.
In 1990 samples at three moisture levels (21%, 25% and 30%) were stored in gunny sacks to get similar condition with corn cribs. Delayed durations are 0, 1, 3, 6, 9 and 14 days.

Achievement : 80%

Problem Remained

Standardization of the Standard Oven Method (1988-1990)

Research Implementation Plan
2.Improvement of test technics
(2) Improvement of simplified moisture meter
Code No. II-2-(2)

Pimol Wuttisin, Sriwai Singhagajen
Nobuyoshi Ishitani, Makoto Kobayashi, Mitsuhisa Harada

Summary
This experiment was conducted to standardize oven method in this project. In 1988 and in 1989, we compared various method of moisture determination. Among several standard methods, we selected USDA method (15g, 103°C, 72hrs) for reference. And oven methods, with 5g or 15g, whole kernel or ground, pre dried or not, at different temperature and drying time were tested. 5g-130°C-4hr-whole kernel method was selected among them and calibrated by USDA method.
In 1990, we tested effect of drying time (4 to 6 hours), tempering (0 to 2 days) and absolute humidity (US 0.0080 kg·water/kg·air, Thai 0.0192). Standard error by calibration is about 0.4% and is still too large for standard method, but enough for simplified method. Drying time had no effect on decreasing error. Absolute humidity had a smll effect and negligeble at this accuracy. But samples stored after preparation (tempering) showed smaller deviation.

Achievement : 70%

Problem Remained
Deviation of calibrated moisture content from measured value is still higher than expected.

Calibration Test of Established Moisture Meter (1988-1990)

Research Implementation Plan
2.Improvement of test technics
(2) Improvement of simplified moisture meter
Code No. II-2-(2)

Pimol Wuttisin, Sriwai Singhagajen
Nobuyoshi Ishitani, Makoto Kobayashi, Mitsuhisa Harada

Summary
This experiment was conducted to calibrate moisture meter in practical use in Thailand.
Three meters, resistance meter CTR-800, capacitance meter Dole-400 and Grainer, were tested in 1988 and Grainer was rejected for lack of linearity.
In 1989 two capacitance meters, KU meter and Multi Garain, were newly applied for calibration test and CtR-800 was substituted by CTR-160. But they showed rather low coefficiency with determined values by oven method.
In 1990, to delete effects of measuring conditions, we again calibrated the same four meters. 12 lots of ear maize in four varieties were shelled and prepared into seven to nine moisture contents. Samples are mesured the next day and following two days (tempering). They showed better relations between determined values by oven and moisture meters than previous year. Resistance type meter showed linearity. But other three capacitance meters showed similar curves. Tempering resulted in larger deviations. All meters showed larger error at high moisture content.

Achievement : 90%

Problems Remained
By this data, moisture meters could be calibrated by thier producers.

Improvement and Develpoment of moisture meter (1989-)

Research Implementation Plan
2.Improvement of test technics
(2) Improvement of simplified moisture meter
Code No. II-2-(2)

Pimol Wuttisin, Sriwai Singhagajen
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Summary
This experiment was conducted to develop a moisture meter for ear maize in Thailand.
In 1989, two types of electrode ,knife blade and plier type, were tested to apply to resistant type moisture meter "CD-2L", and plier type of electrodes were selected. This year, measured values by ear maize meter was calibrated by CTR-800. Correlations of these values are rather low with coefficient (r-square) 0.53.
In 1990, to raise correlation between measured value and determined value by oven, we tried another size of electrode together and calibrated the meter by portions of ear maize. 12 lots of ear maize sample in four varieties were stored in ambient conditions and measured by these meters and calibrated by oven method.
Correlation coefficient (r-square) raised up to 0.88 and error of estimated value of ear maize meter from oven determination reduced to 1.6% by quadratic regression.

Achievement : 60%

Problems Remained
To make handy meter, small and light electrode should be developed.
Tested samples were stored for some period before experiment. Freshly harvested ear maize has not yet been calibrated.

Study on the Corn Sheller Improvement for High Moisture Maize

Research Implimentation Plan
3.Countermeasure of aflatoxin prevention
(2)Improvemrnt of post-harvest practice
Code No. Ⅱ-3-(2)-A (1988-)

Nitat Tangpinijkul, Sriwai Singhagajen
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I Performance Test of Established Corn Sheller for High Moisture Maize

Summary (1988)
This experiment was conducted to evaluate corn shellers in current use for basic data of improving shellers.
Four types of established corn shellers (one spring sheller, Chikuma, and three axial flow shellers. Lotus 77; plate tooth, Alvan Branch; rasp-bar tooht and NCR-1200; spike tooth) were tested in the applied speed range, using maize at various moisture content ranging from 16 to 30%, to find out a cylinder type with low broken kernel ratio.
Peripheral speed gave no effect on breakage under designed range.
Among the four, the spring sheller showed higher ratio of unshelled kernel than other axial flow cylinder shellers.
Among axisl flow cylinders, difference of breakage was rather small at low moisture content. But at high moisture content of 30 %, spike tooth cylinder , rasp-bar cylinder and plate tooth cylinder showed breakage of 6%, 6.5% and 9% respectively.

Ⅱ Analysis of the Relation between Mechanical Damage to Kernel, Machinery Design, Operational Condition and Moisture Content of Maize (1989)

Summary
Five types of cylinder tooth (plate tooth, alternative direction plate tooth, spike tooth, rectangular spike tooth and rasp-bar tooth, seven types including concave clearance) were tested to analyze relation between damage of kernels and types of cylinder drums, with five different peripheral speed and four different moisture content of maize.
Peripheral speed, kernel moisture content and type of cylinder have effect on rate of brekage in order of degree.
Tested cylinders showed lower rate of breakage than previous year's models, and two types of cylinders (rectangular spike tooth cylinder and spike tooth cylinder) were selected for the prototypes of improved corn sheller.

Ⅲ Corn Sheller Improvement (1990-)

Summary
Three types of proto-type cylinders (rectangular spike tooth with drum, spike tooth with drum and spike tooth with cage cylinder) were tested with ear maize at 18, 22, 26 and 39% moisture content, at four different peripheral speed of 5 to 12.5 m/s.
Ratio of breakage was lower than former year at 18, 22 and 26% moisture content. Ratio of breakage incresed rapidly at moisture content of 30%.

But peripheral speed has no effect on breakage within examined range. Among them, there is no significant difference about the rate of breakage. For unshelled, speed is most effective. But at speed of 10 to 12.5 m/s, there is little difference among the four. About power consumption, reference model of plate tooth cylinder showed significantly high value. For the proto-type of improved sheller, no model among the three seems to be more adequate than others. This suggests that these three tested models are equivalent in performance. And from the tendency of these three years' result, it also could be suggested that precision of fabrication has a big effect on performance of the corn sheller. Concerning fabrication and maintenance of sheller, we selected spike tooth cage type cylinder for improved corn sheller.
Agromony section suggested that harvesting and storing with husk resulted in low contamination level of aflatoxin. To shell ear maize harvested and stored with husk, trial sheller with rasp bar cylinder showed good performance. Ratio of breakage was below 4% at peripheral speed of 10 or 12.5%, and it might be lower than last years' shelling without husk. The ratio of brekage was a little lower for maize stored 30 days than 60 days.

Achievement : I 90%
II 80%
III 70%

Problems Remained
Rapid increase of breakage ratio at 30% of moisture content is not explained.
Operational condition of cleaning part should be adjusted for improved corn sheller.

Development of Simple Drying Method (1989-)

Research Implementation Plan
3.Countermeasure of aflatoxin prevention
(2)Improvement of post-harvest practice
Code No. Ⅱ-3-(2)-B-b Related to Ⅱ-1-(2)-C-c

Ⅰ Simple drying method -1
The solar energy and engine exhaust heat-supplemented ambient air drying method (1989)

Pimol Wuttisin, Keiichi Inoue, Sriwai Singhagajen, Makoto Kobayashi

Summary
To develop a cheap and less energy intensive method to dry maize, two solar and forced air drying unit (closed circulation type - No.1, open circulation type with dehumidifier - No.2) were fabricated.
No.1 showed higher temperature and humidity. No.1 showed more rapid drying rate than No.2, and this was explained by lower equilibrium moisture content by higher temperature. In this experiment, ear maize kept on drying until 60 hours from start, and later it absorbed moisture in the air at night time.

Ⅱ Simple drying method -2
Research on drying ear maize with vinyl plastic house (solar heat drying) (1990)

Pimol Wuttisin, Chaiwat Paosantadpanich, Arunsri Wongurai
Sriwai Singhagajen, Akira Matsuzaki, Mitsuhisa Harada, Katsusuke Arai

Summary
To dry more maize with solar heat, three layered plastic house with closed system were fabricated and compared with one layer open type.
It took two weeks to dry maize from 28% to 14% by the modified solar house, and it also showed the similar transition of moisture content by one layered solar house.

Achievement : Ⅰ 70%
Ⅱ 70%

Problems Remained
For extension, construction and maintenance cost of the facility must be reduced.

Table 1 Sun Dry of Maize in Laboratory Scale

Sample No.	Expt. Date Sep. 90	Weather	Moist. % start	Thickness cm	Required time to 18 % hrs	Required days to 14%	Required time hrs	Kernel temp. Surf. ℃	Kernel temp. Bott. ℃	Concret temp. ℃ Max.	RH max %	RH min %
L-1	18~19	Fair	27	1	7	2	12	46	45	56	87	44
L-2	18~20	"	27	3	12	3	19	49	45	56	87	44
L-3	18~20	"	27	4	15	3	22	45	40	56	87	44
L-4	19	Fair	24	1	2	1	5	45	41	43	74	50
L-5	19~20	"	24	3	4	2	10	49	41	43	84	50
L-6	19~20	"	24	4	5	2	12	44	40	42	84	50
L-7	25~29	Rain 2	24	1	8	5	26	40	40	46	92	61
L-8	25~29	" 2	24	3	12	5	30	45	29	46	92	61
L-9	25~30	" 3	24	4	15	6	35	47	29	46	92	61
L-10	26~27	Rain 1	28	1	13	2	13	48	46	46	92	61
L-11	26~29	" 2	28	3	25	4	16	48	39	46	92	61
L-12	26~29	" 2	28	4	23	4	23	46	40	46	92	61

Table 2

Changes of A. flavus Infection and Aflatoxin Content in Maize During Sun Dry (Laboratory Scale)

Sample No.	Expt. Date Sep. 90	A. flavus Start %	A. flavus Finish %	Aflatoxin B_1 Start ppb	Aflatoxin B_1 Finish ppb
L-1	18~19	31	25	36	11
L-2	18~20	"	25	"	41
L-3	18~20	"	26	"	23
L-4	19	15	31	115	92
L-5	19~20	"	20	"	59
L-6	19~20	"	12	"	73
L-7	25~29	1	1	75	70
L-8	25~29	"	4	"	60
L-9	25~30	"	9	"	100
L-10	26~27	24	34	763	1012
L-11	26~29	"	36	"	852
L-12	26~29	"	67	"	1263

Table 3 Sun Dry of Maize in Middleman Scale

Sample No.	Expt. Date Sept. 90	Weather	Moist. % start	Thickness cm	Required time to 18% hrs	Required days to 14%	Required time hrs	Kernel temp. Surf. ℃	Kernel temp. Bott. ℃	Concret temp. ℃ Max.	RH Max. %	RH Min. %
D-1	18~19	Fair	26	1~4	3	2	9	46	45	51	71	39
D-2	19	"	26	1~4	3	1	9	50	48	48	72	55
D-3	19	Fair	24	1~4	1.5	1	7	50	49	50	69	55
D-4	19	"	24	1~4	1.5	1	8	44	42	48	65	48
D-5	25~29	Rain 2	23	1~4	10	5	27	37	42	40	75	69
D-6	26~30	" 2	23	1~4	15	5	28	42	40	45	84	68
D-7	27~30	Rain 2	27	1~4	5	4	17	38	35	40	96	44
D-8	28~29	" 2	27	1~4	9	2	13	46	40	48	85	44

Table 4

Changes of A. flavus Infection and Aflatoxin Content in Maize During Sun Dry (Middleman Scale)

Sample No.	Expt. Date Sep. 90	A. flavus Start %	A. flavus Finish %	Aflatoxin Start ppb	Aflatoxin Finish ppb	3 months stored A. fl % av.	3 months stored AF ppb av.
D-1	18~19	6	21	11	ND	17	15
D-2	19	38	43	11	ND	30	17
D-3	19	13	31	193	106	26	131
D-4	19	31	95	193	290	44	335
D-5	25~29	0	9	37	21	13	68
D-6	26~30	5	19	37	209	31	199
D-7	27~30	12	24	1100	845	35	814
D-8	28~29	37	41	1100	703	56	573

Study on the Chemical Control of Aspergillus spp. in maize (1988-)

Research Implementation Plan
3.Countermeasure of aflatoxin prevention during post-harvest process
(2)Improvement of post-harvest practices
Code No. II-3-(2)-C-(a)

Chaiwat Paosantadpanich, Srichai , Arunsri Wongurai, Sriwai Singhagajen
Mikio Kamo, Makoto Kobayashi, Mitsuhisa Harada, Katsusuke Arai

I Ammonia treatment of maize to control Aspergillus spp. and so prevent aflatoxin contamination.(1988)

Summary
This experiment was conducted to estimate the effect of ammonia treatment for prevention of aflatoxin contamination and to develop a practical method of ammonia treatment for maize.
Ammonia solution, anhydrous liquid ammonia and urea with soybean extract were tested as ammonia sources. 80 kg of shelled maize and 60 kg of ear maize at 20%, 25% and 30 % of moisture content was treated with 0.5% of ammonia by sample weight for two weeks, and were stored in storage for one month. All treatment could inhibit A.flavus miltiplication. But their effect varies according to the ammonia source, and all samples were infected by A. flavus after one month storage. At every treatment, discoloration and fermented smell were observed, which were not accepted by middlemen.

II Urea treatment of Maize to control Aspergillus spp. and so prevent aflatoxin contamination. (1989)

Summary
This experiment was conducted to develop safe and inexpensive ammonia treatment reducing discoloration.
Natural evaporation method and soaking method were tested for urea treatment.
In natural evaporation treatment, each 280 kg of ear maize was plied on ammonia evaporating container and covered with plastic films for all two weeks or only night and rainy days. samples gain moisture and got discolored in covered treatment and ammonia was not absorbed equally in open treatment.
In soaking method, samples were dipped into urea solution and soybean emulsion and stored in open or closed corn cribs for six weeks. After treatment, fungus and yeast were observed after treatment and more during storage period. Discoloration was also observed in both treatment. This method has problems that it raise moisture content and that it induce fermentation.

III Ammonia and sulfur dioxide supplemented ambient air drying of high moisture maize in Thailand. (1989)

Summary
Trickle ammonia process (TAP) and trickle sulfur dioxide process (TSDP)

were tested their potential in Thailand and to develop an instore-drying method with less discoloration.
In both TAP and TSDP we applied 0.5% sample weight of chemical and air flow rate of 1m^3/min·ton. for TAP anhydrous ammonia was applied at flowing rate of 15l/min. at one or three injection. And for TSDP we burned sulfur cake and flow sulfur dioxide through inlet of air.
TAP could prohibit mold growth but induced discoloration. TSDP did not cause discoloration, but mold was observed after two or three days from treatment.

IV Sulfur dioxide supplemented storage of high moisture maize. (1989-1990)

Summary
To evaluate sulfur dioxide fumigation, we burned sulfur cake and stored ear maize for six weeks.
In 1989, Concentration of sulfur dioxede was 0.05% by weight. There was no problem for the distribution of sulfur dioxide gas, but after storage, ear maize were infected by A. flavus.
In 1990, we fabricated a small burner and each 650kg of ear maize was treated in a small crib. 0.5% treatment and intermittent treatment of 0.5%, 0.25% and 0.125% at three days intervals were evaluated. No sulfur residual was detected from 0.25% and 0.125% treatment. Also aflatoxin was not detected during intermittent treatment.

Achievement : I 80%
II 80%
III 80%
IV 80%

Problems Remained
In farmers storage, safe and simple burner for sulfur cake is necessary. Sulfur dioxide should be applied until maize would be dried to safty moist ure content.

Study on the Improvement of Storage Facilities for Farmers (1989-)

Research Implementation Plan
3.Countermeasure of aflatoxin prevention
(2)Improvement of post-harvest practice
Code No. Ⅱ-3-(2)-C-c

Chaiwat Paosantadpanich, Arunsri Wongurai, Sriwai Singhagajen
Makoto Kobayashi, Mitsuhisa Harada, Katsusuke Arai

Summary
This experiment was conducted to clarify the changes of conditions in farmers' storage and to improve farmers' storage facilities.
In 1989 experimental models of the elevated and ground floor corn cribs (2.6m * 2.6m * 1.8m) were constructed and each 5.1 tons of ear maize was stored to compare inner conditions.
In both crib, heat spot 6°C higher than ambient temperature wsa observed at a distance west side and upper from center of the crib. These two corn cribs are not different so much.
In 1990, two corn cribs with elevated foor were constructed and three air duct, one at bottom and two in upper middle part) were installed in one crib. Each approx. 5 tons of ear maize were stored for 63 days and temperature transition were checked at five layers.
This year, temperature raise is not so large as previous year. But heated area was also observed in its center. Temperature raise seemed to be controled in modified crib specially by the duct at its bottom. Aflatoxin contamination started one week from storage, and there is no significant difference of contamination in both cribs.

Achievement : 70%

Problems Remained
Some part of temperature raise was controled by air duct. But still we could get no progress on aflatoxin contamination. We should research about the possibility to apply forced air or heated air to corn crib.

Research Plan of Post-Havest Section in 1991 Crop Season

1) Corn sheller improvement
   Code No. Ⅱ-3-(2)-A (1990-1991)

2) Study on the practical operation of in-stored drying
   2-1. Study on the improvement of storage facilities for farmers
        Code No. Ⅱ-3-(2)-C-(a) (1989-1991)
   2-2. Simple drying method-3
        Study on the ambient and heated air drying in farmers' storage
        Code No. Ⅱ-3-(2)-B and Ⅱ-3-(2)-C-(c) (1991)

3) Evaluation of ambient air and heated air drying
   Code No. Ⅱ-3-(2)-B-(b) (1991)

4) Study on moisture determination of maize
   4-1. Performance test of newly developed moisture meter for ear maize
        Code No. Ⅱ-2-(2) (1988-1991)
   4-2. Moisture determination by oven methods
        Code No. Ⅱ-2-(2) (1991)

5) Study on the sulfur dioxide treatment in farmer' storage
   Code No. Ⅱ-3-(2)-C-(a) and Ⅱ-3-(2)-C-(c) (1991)