附　属　資　料

ミニッツ

(1)　タイ側経過報告

(2)　日本側経過報告

(3)　調査団サマリーレポート

(4)　試験結果

MINUTES OF DISCUSSIONS

THE MAIZE QUALITY IMPROVEMENT RESEARCH CENTRE PROJECT

The Japanese Technical Guidance Team, organized by Japan International Cooperation Agency, headed by Dr. Masaru Manabe, Director of Applied Microbiology Division, National Food Research Institute, MAFF, visited the Kingdom of Thailand from March 7 to 18, 1989. The main purpose of the team was to discuss and review the present status of the actual implementation, based on the Tentative Implementation Programme (TIP), of the research activities for the Project.

During stay in Thailand, the team exchanged views and had discussions with the authorities concerned referring to the project activities, to be carried out in accordance with the Tentative Implementation Programme.

As a result of the discussions, both sides came to a good understanding of the matters attached hereto.

Bangkok, March 16, 1989.

Masaru Manabe

Dr. Masaru Manabe
Leader,
The Japanese Technical
Guidance Team,
Japan International
Cooperation Agency

D. Chandrapanya

Dr. Damkhoeng Chandrapanya
Assistant Director;
The Maize Quality Improvement
Research Centre Project

Witnessed by

Riksh Syamananda

Dr. Riksh Syamananda
Director-General,
Department of Agriculture,
Ministry of Agriculture
and Cooperatives

THE MEETING OF THE JOINT COMMITTEE
FOR
THE MAIZE QUALITY IMPROVEMENT RESEARCH CENTRE PROJECT

(at 5th Floor, Room No. 501, Department of Agriculture)

Agenda

Thursday 16th March, 1989

10:00-10:05	Opening address by the Director-General of DOA
10:05-10:10	Address by the Team Leader, Technical Guidance Team
10:10-10:15	Adoption of the proposed agenda
10:15-10:35	Progress report by Thai side
10:35-10:55	Progress report by Japanese side
10:55-11:30	Summary report by Japanese Technical Guidance Team
11:30-11:40	General Discussions
11:40-11:50	Summarization and Adoption
11:50-12:00	Closing Address by the Director-General of DOA

MEMBERS OF JAPANESE TECHNICAL GUIDANCE TEAM, JICA

Leader; Dr. Masaru Manabe

(Microbe) Director, Applied Microbiology Department, National Food Research Institute, Ministry of Agriculture, Forestry and Fisheries (MAFF)

Agronomy; Mr. Takao Tsukiboshi

Researcher, Lab. of Plant Pathology, Department of Environment, National Grassland Research Institute, Ministry of Agriculture, Forestry and Fisheries (MAFF)

Post-Harvest; Mr. Yusaku Nagatomo

Chief, Seed Inspection Division, Kumamoto National Livestock Breeding Station, Ministry of Agriculture, Forestry and Fisheries (MAFF)

Coordinator; Mr. Naoki Ando

Staff, Agricultural Development Div., Agricultural Development Cooperation Department, Japan International Cooperation Agency (JICA)

The Tentative Schedule
For
The Japanese Technical Guidance Team

Mar.07 (Tue)		Arrival in Bangkok (TG 641)
Mar.08 (Wed)	09:30-11:10	Courtesy call to the JICA office and the Japanese Embassy
	13:30-14:30	Courtesy call to the DOA
	14:30-14:45	Meeting with the Project Director Dr. Tanongchit Wongsiri
	14:45-16:30	Discussion with Japanese experts on the schedule
Mar.09 (Thu)	08:30-11:30	Discussion with Japanese experts on research
	12:00-13:30	(Luncheon, hosted by the JICA Project Team)
	14:00-16:00	Discussion with Thai side counter-parts on the project activities (Admin. Section)
Mar.10 (Fri)	09:30-11:30	Discussion with Thai side counter-parts on the project activities (Agronomy Section)
	14:00-16:00	- Ditto - (Microbe Section)
Mar.11 (Sat)	09:00-	Observation trip to Phraputtabaht
Mar.12 (Sun)		Observation trip to maize production area
Mar.13 (Mon)	09:30-11:30	Discussion with Thai side counter-parts on the project activities (Post-Harvrest Section)
	13:30-16:00	Meeting with the Directors of each division
Mar.14 (Tue)	09:30-	Meeting with Japanese experts
Mar.15 (Wed)	09:30-	Report preparation for the Joint Committee Meeting
Mar.16 (Thu)	10:00-12:00	The Joint Committee Meeting
	12:00-13:30	(Luncheon, hosted by the DOA)
	18:30-20:00	(Dinner party, hosted by the Technical Guidance Team)
Mar.17 (Fri)	09:30-	Report to the JICA office and the Japanese Embassy
Mar.18 (Sat)		Departure to Tokyo (TG 640)

CONTENTS

I. PROGRESS REPORT

THAI SIDE

(PROJECT DIRECTOR)

Progress Report (Thai Side)

I. The Centre for Maize Quality Improvement

The Thai working groups and the Japanese experts for the Maize Quality Improvement Research Centre Project moved to the new project building in May, 1988. The Administration, the Post-Harvest and the Microbe Sections spend most of their time working at the centre. The Agronomy Section only occasionally works at the project centre laboratory, as its main research is conducted at the Phrabuttabaht Field Crops Experiment Station in Lopburi Province.

The opening ceremony of the Centre for Maize Quality Improvement, presided over by Her Royal Highness Princess Maha Chakkri Sirindhorn, was held on May 31st, 1988.

II. Administration Structure and Operation System of the Maize Quality Improvement Research Centre Project.

The DOA appointment order presented at the Joint Committee meeting on April 5th, 1988 appointed the Director of the Project, members of the Joint Committee, Coordinating Committee and Coordinating Sub-Committee. Since this order, the following additional orders have been given. (refer to Annex 1)

1. The appointment of Thai counterparts to the experts of the project. (DOA Order No. 1073/1988 dated March 29th, 1988)

2. The appointment of Mr. Damkheong Chandrapanya, Director of Planning and Technical Division as the Assistant Project Director. (DOA Order No. 1719/1988 dated May 20th, 1988)

3. The appointment of the Working Groups for the Coordinating Committee of the project. (DOA Order No. 1720/1988 and No. 4549/1988 dated May 20th, and December 21st, 1988, respectively)

4. The appointment of officers for the Maize Quality Improvement Centre. (DOA Order No. 1721/1988, No. 2837/1988 and No. 4548/1988 dated May 20th, August 16th, and December 21st, 1988, respectively)

III. Office Furniture

In the 1988 budget, the Department of Agriculture purchased office furniture for the Maize Quality Improvement Centre such as desks with chairs, cabinets, a sofa, white boards, knock down shelves, a printing machine, an electric typewriter, calculators, etc. The purchases for the whole year totalled Baht 133,118. (refer to Table 1)

IV. The Project Committee Meetings

In 1988 the Project Committee meetings were held as follows :

1. The Coordinating Committee meetings were held on the dates hereafter :

   March 14th, 1988
   August 2nd, 1988
   December 22nd, 1988

2. The Coordinating Sub-Committee meetings were held on the dates hereafter :

   January 15th, 1988
   February 25th, 1988
   June 29th, 1988
   October 17th, 1988
   December 8th, 1988
   February 17th, 1989

3. The Working Group meetings were held by the respective section members when necessary.

V. Budget for the Project

The Royal Thai Government (RTG) provided the budgets for the project as follows : (refer to Table 2)

1987 Fiscal Year approved 2,028,900 Baht
1988 Fiscal Year approved 2,919,017 Baht
1989 Fiscal Year approved 2,945,080 Baht
1990 Fiscal Year proposed 5,804,500 Baht

However, the budget proposed by the Project Director (for the period of 5 years) totalled 16 million baht.
The 1990 budget is higher than other years since the project plans to expand its research activities, which will be able to provide more accurate information for further study.
Moreover, a sufficient number of staff were not employed and the situation caused the project to make a budget request for an additional 12 people. Further, more budget was requested for chemicals, other substances and public utility costs.

VI. The Project Staff

1. The present staff are the following :

   1) Permanent officers 29 people

Administration Section	8	people
Post-Harvest Section	6	people
Agronomy Section	10	people
Microbe Section	5	people

   2) Temporary employees for the 1988 fiscal year totalled 35 people and in 1989, one staff member was added to the Administration Section as shown below :

Administration Section	10	people
(a policy and planning analyst was added)		
Post-Harvest Section	9	people
Agronomy Section	10	people
Microbe Section	7	people

2. The additional temporary staff proposed for the 1990 fiscal year.

12 additional temporary employees are proposed as follows:

Administration Section (accountant)	1	person
Post-Harvest Section (scientist 1, technician 3)	4	people
Agronomy Section	-	person
Microbe Section (researcher 2, technician 1, worker 4)	7	people

3. Recently, the Project Administration informed each section that it was working on the appointment of permanent officers and employees who will be required to serve the project after its end.

VII. Research Activities

A field trip and spot discussion related to Agronomy were held at the Phrabuttabaht Field Crop Experiment Station on October 2nd, 1988. The Project Director and many staff concerned with the project attended. Presentations on other research activities of the project will be given by the Japanese side.

VIII. Problems

1. The insufficient number of staff.

2. Operational space and facilities for research activities were not sufficiently available.

3. The present budget did not cover all expenses, especially the public utility expenses. In addition, a public utility budget should be set for the Phrabuttabaht Field Crop Experiment Station and separated from that of the Maize Quality Improvement Centre.

IX. Area Expansion of the Centre

At present, the space available and facilities available are not enough for the research activities. The Coordinating Committee and the Coordinating Sub-Committee, therefore, agreed to submit a proposal to expand the area of the Centre to the Executive Committee and it will be attached to the agenda of general discussion.

Table 1. List of Furniture for the Maize Quality Improvement Centre

(RTG Budget : 1988 Fiscal Year)

No.	Items	Amount	Unit Price	Total
1.	Desk with chairs (Level 1-2)	2	719	1,438
2.	Desk with chairs (Level 3-6)	20	1,340	26,800
3.	Desk 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
	Total			133,118

Table 2. RTG Budget for The Maize Quality Improvement Research Centre Project

Year \ Item	Temporary Wages	Operational Cost	Public Utility Cost	Civil Work & Equipment Cost	Total
1st Year (approved)	- -	- -	- -	2,028,900 -	2,028,900
2nd Year (approved)	332,995 -	979,120 -	246,200 -	1,360,702 -	2,919,017
3rd Year (approved)	824,080 -	1,874,800 -	246,200 -	- -	2,945,080
4th Year (proposed)	1,481,000 -	3,667,500 -	656,000 -	- -	5,804,500
	Total				13,697,497

Remarks
1st Year = Oct. 1986 - Sept. 1987
2nd Year = Oct. 1987 - Sept. 1988
3rd Year = Oct. 1988 - Sept. 1989
4th Year = Oct. 1989 - Sept. 1990

ANNEX I.

DOA ORDER

AND

ADMINISTRATION SYSTEM

DOA ORDER

No. 1073/1988

Appointment of the Counterparts for the Expert of the Maize Quality Improvement Research Centre Project

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To cooperate closely with the Japanese experts provided by the Government of Japan through the Japan International Cooperation Agency (JICA), the Department of Agriculture (DOA) appointed the following officials as counterparts for the Maize Quality Improvement Research Centre Project as follows :

1. Mr. Narongsak Senanarong
   Agricultural Scientist Level 8,
   Field Crops Research Institute as a counterpart for Mr. Teruhiko Nibe, Expert for Agronomy

2. Mrs. Sriwai Singhagajen
   Agricultural Engineer Level 8,
   Agricultural Engineering Division as a counterpart for Mr. Makoto Kobayashi, Expert for Post-harvest

3. Mr. Vijai Nopamornbodi
   Agricultural Scientist Level 7,
   Planning and Technical Division as a counterpart for Mr. Takeji Seino,
   Project Coordinator, Japanese side

4. Mr. Prawat Tanboon-ek
   Plant Pathology Level 7,
   Plant Pathology and Microbiology Division as a counterpart for the Microbe Experts

The appointed counterparts will be responsible to joint consideration on the formulation of work plan and for cooporation with agencies concerning the Maize Quality Improvement Research Centre Project.

Effective by March 29, 1988

(Mr. Riksh Sayamananda)
Director-General,
Department of Agriculture
March 29, 1988

DOA Order

No.1719/2531

Title on The appointment of Assistant Director of the Maize Quality Improvement Research Centre Project.

Due to DOA order No.341/2531 dated on Febuary 2, 1988 appointed Director of the Maize Quality Improvement Research Centre Project.

In order to carry out the project activities effectively, DOA would like to appoint Director of Planning and Technical Division to be an Assistant Director of the Maize Quality Improvement Research Centre Project.

Effective as from now.

May 20, 1988.
Mr.Tanongchit Wongsiri
Deputy Director General
Acting Director General
Department of Agriculture

DOA Order

No.1720/1988

The appointment of Working Groups of the Coordinating Committee of the Maize Quality Improvement Research Centre Project.

Following the Department of Agriculture (DOA) Order subject to the appointment of the Coordinating Committee for the Maize Quality Impprovement Research Centre Project, DOA appointed four working groups for the Committee to encourage an effective implementation of the project as follows :

1 Administration Working Group (Planning and Technical Division)

1)	Director of Planning and Technical Division	Head
2)	Mr.Vijai Nopamornbodi, Agricultural Scientist Level 7	Assist.Head
3)	Mrs.Siriporn Sindhusake, Agricultural Scientist Level 6	staff
4)	Mrs.Saranya Busparock, Agricultural Scientist Level 6	staff
5)	Mrs.Boonluck Seetanun, Agricultural Scientist Level 6	staff
6)	Mrs.Permpoon Sarnthoy, Agricultural Scientist Level 5	staff
7)	Mr.Takeji Seino, Janpanese Project Coordinator	staff
8)	Mrs.Sunthree Niamgrum, Clerk 3	staff & secretary

2 Post Harvest Working Group (Agricultural Engineering Division)

1)	Director of Agricultural Engineering Division	Head
2)	Mrs.Sriwai Singhagajen, Agricultural Engineer Level 8	Assist.Head
3)	Mr.Mitri Naewbanij, Agricultural Engineer Level 5	staff
4)	Mr.Nitat Tangpinijkul, Agricultural Engineer Level 5	staff
5)	Mr.Pimol Wuttisin, Agricultural Engineer Level 4	staff
6)	Mr.Makoto Kobayashi, Janpanese Post Harvest Expert	staff
7)	Mr.Chaiwat Paosantadpanich, Agricultural Engineer Level 3	staff & secretary

3 Field Crops Working Group (Field Crops Research Institute)

1)	Director of Field Crops Research Institute	Head
2)	Mr.Narongsak Senanarong, Agricultural Scientist Level 8	Assist.Head
3)	Director of Nakhornsawan Field Crops Research Centre	staff

4) Director of Prabuddhabat Field Crops Experiment Station — staff
5) Mr.Prasop Thepayasuvan, Agricultural Scientist Level 6 — staff
6) Mr.Somrak Naradechanon, Agricultural Scientist Level 6 — staff
7) Mrs.Lily Kaveeta, Agricultural Scientist Level 5 — staff
8) Mr.Teruhiko Nibe, Janpanese Field Crops Expert — staff
9) Mr.Sompong Tongchuoy, Agricultural Scientist Level 3 — staff
10) Mr.Sukapong Wayupap, Agricultural Scientist Level 5 — staff & secretary

4 Microbe Working Group (Plant Pathology and Microbiology Division

1) Director of Plant Pathology and Microbiology Division — Head
2) Mr.Prawat Tanboon-ek, Plant Pathologist Level 7 — Assist.Head
3) Mrs.Kanjana Bhudhasamai, Plant Pathologist Level 7 — staff
4) Mr. Katsusuke Arai Japanese Microbe Expert — staff
5) Mrs.Arunsri Wongurai, Plant Pathologist Level 5 — staff & secretary

Duties of Working Groups are

1. To coordinate the planning of the performance, administration and research , follow up and collect reports to the Coordinating Committee of the Maize Quality Improvement Research Centre Project.
2. To implement the research activities of the project.
3. To carry out orders from the Coordinating Committee of the Maize Quality Improvement Research Centre Project.

It is effective from now.

May 20, 1988.
Mr.Tanongchit Wongsiri
Deputy Director General
Acting Director General
Department of Agriculture

DOA ORDER

No. 4549/1988

Subject : Appointment of Working Group of the Coordinating Committee for the Maize Quality Improvement Research Centre Project (Additional)

Following DOA Order No. 1720/1988 dated May 20, 1988 subject to the appointment of working group of the Coordinating Committee for the Maize Quality Improvement Research Centre Project, two additional staffs have been assigned to join in the project activities in order to promote the project effeciency as follows :

1) Field Crops Working Group
(Field Crops Research Institute)
1) Mr. Veerawat Nilratanakul
Agricultural Scientist Level 4 member

2) Microbe Working Group
(Plant Pathology and Microbiology Division)
1) Mr. Suparat Kositchareonkul
Plant Pathologist Level 3 member

Both officers will be responsible to duties stated by DOA Order No. 1720/1988 dated May 20, 1988.

Effective Order by December 21, 1988.

(Mr. Riksh Syamananda)
Director-General of DOA

DOA Order

No.1721/2531

Subject : The appointment of the Maize Quality Improvement Centre officers.

With the assistance of the Government of Japan to establish the Centre for Maize Quality Improvement, the Department of Agriculture appointed the following officers in order to carry out service for coordination, administration and research of project activities as effectively as possible to achieve the expected objectives and the goal.

1 Field Crops Group

1)	Mr.Narongsak Senanarong	Agricultural Scientist Level 8
2)	Mr.Salin Phuvipadawat	Agricultural Scientist Level 6
3)	Mrs.Lily Kaweeta	Agricultural Scientist Level 5
4)	Mr.Somchai Wongsri	Temporary Employee
5)	Miss Wanna Seitung	Temporary Employee

2 Microbe Group

1)	Miss Arunsri Wonguri	Plant Pathologist Level 5

3 Post Harvest Group

1)	Mrs.Sriwai Singhagajen	Agricultural Engineer Level 8
2)	Mr.Mitri Naewbanij	Agricultural Engineer Level 5
3)	Mr.Nitat Tangpinijkul	Agricultural Engineer Level 5
4)	Mr.Pimol Wuttisin	Agricultural Engineer Level 4
5)	Mr.Chaiwat Paosantadpanich	Agricultural Engineer Level 3

4 Administration Group

1)	Mr.Vijai Nopamornbodi	Agricultural Scientist Level 7
2)	Mrs.Saranya Busparoek	Agricultural Scientist Level 6
3)	Mrs.Siriporn Sindhusake	Agricultural Scientist Level 6
4)	Mrs.Boonluck Seetanun	Agricultural Scientist Level 6
5)	Mrs.Permpoon Sarnthoy	Agricultural Scientist Level 5

5 Japanese Experts

1)	Mr. T. Yoshiyama	Team Leader, MQIRC Project
2)	Mr. T. Seino	Project Coordinator, MQIRC Project
3)	Mr. M. Kobayashi	Post-harvest Expert, MQIRC Project
4)	Mr. T. Nibe	Agronomy Expert, MQIRC Project
5)	Mr. Katsusuke Arai	Microbe Expert, MQIRC Project

Their duties are as follows :

1. To monitor and coordinate the Maize Quality Improvement Research Centre Project.

2. To take care of equipments of the Maize Quality Improvement Research Centre.
3. To provide cooperation in all project activities of the Maize Quality Improvement Research Project.
4. To look after maintenance of the Centre for Maize Quality Improvement.

Effective as from now.

May 20, 1988.
Mr.Tanongchit Wongsiri
Deputy Director General
Acting Director General
Department of Agriculture

DOA ORDER

No. 4548/1988

Subject : Appointment of the Maize Quality Improvement Centre Officers (Second addition)

Following the Department of Agriculture Order, No. 1721/1988 dated May 20, 1988 and DOA Order No. 2837/1988 dated August 16, 1988 subject to the appointment of staff for the Maize Quality Improvement Research Centre Project, an additional staff is assigned to join the project in order to promote effective implementation of the project.

1) Microbe Group
   1) Mr. Suparat Kositchareonkul
      Plant Pathologist Level 3

The duties stated in DOA Order No. 1721/1988 dated May 20, 1988.

Effective Order by December 21, 1988.

(Mr. Riksh Syamananda)
Director-General of DOA

ADMINISTRATION STRUCTURE

of the Maize Quality Improvement Research Centre Project
(Dec. 15, 1986 - Dec. 14, 1991)

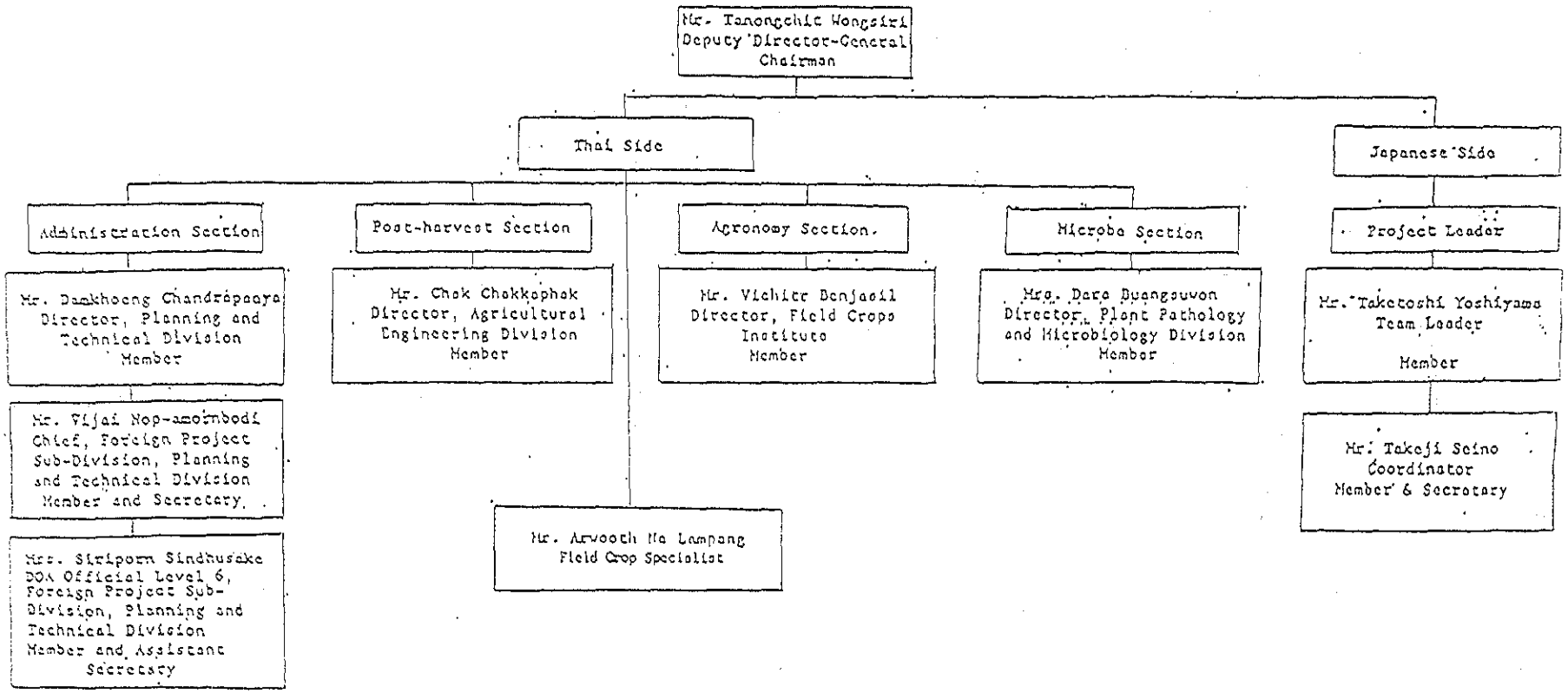
JOINT COMMITTEE

COORDINATING COMMITTEE

COORDINATING SUB-COMMITTEE

WORKING GROUP
(Permanent Officer
and
Temporary Staff)

Coordinating Committee



Coordinating Sub-Committee

Chairman	Mr. Damkheong Chandrapanya	
	Thai Side	Japanese Side
Post-harvest Section	Mrs. Sriwai Singhagajen	Mr. Makoto Kobayashi
Agronomy Section	Mr. Narongsak Senanarong	Mr. Teruhiko Nibe
Microbe Section	Mr. Prawat Tan Boon-ek	Mr. Katsusuke Arai
Administration Section	Mr. Vijai Nop-amornbodi	Mr. Takeji Seino
	Mrs. Siriporn Sindhusake	
Secretary	Mrs. Boonluck Seetanun	
Assistant Secretary	Mrs. Permpoon Sarnthoy	

Representative Counterparts

	Thai Side	Japanese Side
Administration Section	Mr. Vijai Nop-amornbodi	Mr. Takeji Seino
Post-harvest Section	Mrs. Sriwai Singhagajen	Mr. Makoto Kobayashi
Agronomy Section	Mr. Narongsak Senanarong	Mr. Teruhiko Nibe
Microbe Section	Mr. Prawat Tan Boon-ek	Mr. Katsusuke Arai
General	Mr. Tanongchit Wongsiri	Mr. Taketoshi Yoshiyama

Feb. 1, 1989

WORKING GROUP (Permanent Officer)

- Mr. Tanongchit Wongsiri — Project Director (Deputy Director-General)
- Mr. Taketoshi Yoshiyama — Team Leader
- Mr. Damkheong Chandrapanya — Assistant Project Director (Director of Planning and Technical Division)

Administration Section

- Mr. Damkheong Chandrapanya (Director of Planning and Technical Division)
- ○ Mr. Vijai Nopamornbodi (Senior Researcher, Chief of the Section)
- Mrs. Siriporn Sindhuwake (Researcher)
- Mrs. Saranya Buaparoek (Researcher)
- Mrs. Boonluck Seetamun (Researcher)
- Mrs. Pornpoon Sarnchoy (Researcher)
- ○ Mr. Takeji Seino (Japanese Project Coordinator)
- Mrs. Sunthree Niamgrum (Clerk)

Post-Harvest Section

- Mr. Chak Chukkaphak (Director of Agricultural Engineering Division)
- ○ Mrs. Srivai Singhagajen (Senior Researcher, Chief of the Section)
- Mr. Mitri Naevbanij (Engineer)
- Mr. Nitat Tangpinijkul (Engineer)
- Mr. Pimol Wuttisin (Engineer)
- ○ Mr. Makoto Kobayashi (Japanese Post Harvest Expert)
- Mr. Chaiwat Paosantadpanich (Engineer)

Agronomy Section

- Mr. Vichitr Senjasilapa (Director of Field Crop Research Institute)
- ○ Mr. Haroonsak Senanarong (Senior Researcher, Chief of the Section)
- Mr. Amnuay Tongdee (Director of Nakhornsavan Field Crops Research Center)
- Mr. Pramern Vesa-ural (Director of Prabuddhabat Field Crops Experiment Station)
- Mr. Prasop Thepyasuvan (Researcher)
- Mr. Somrak Noradechanon (Researcher)
- ○ Mr. Teruhiko Nibe (Japanese Field Crops Expert)
- Mr. Soupong Tongchuoy (Researcher)
- Mr. Sukapong Vayuparp (Researcher)
- Mr. Veeravat Hinratanakul (Researcher)

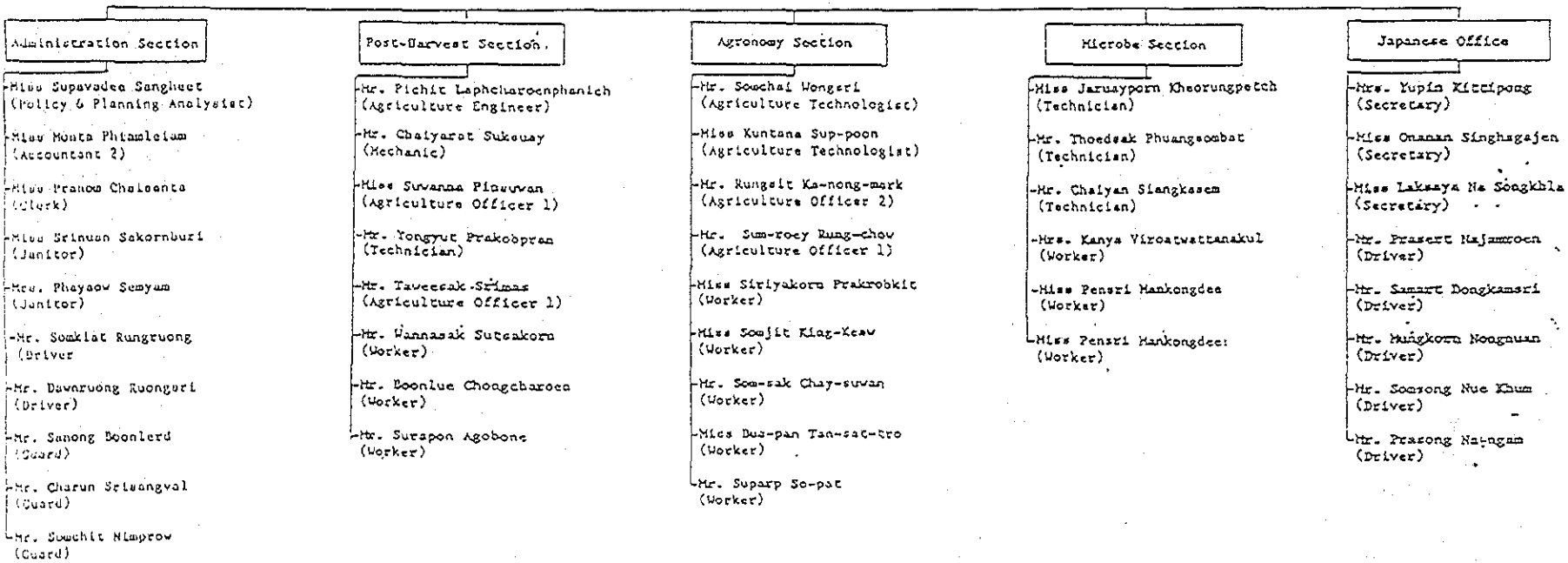
Microbe Section

- Mrs. Dara Buangsuwon (Director of Plant Pathology and Microbiology Division)
- ○ Mr. Pravat Tan Boon-ek (Senior Researcher, Chief of the Section)
- Mrs. Kanjana Bhudhasamai (Researcher)
- ○ Mr. Katsusuke Arai (Japanese Microbiological Expert)
- Miss Arunsri Wongsrai (Researcher)
- Mr. Suparat Kositcharoenkul (Researcher)

○ Representative Counterparts

Feb. 1, 1989

WORKING GROUP (Temporary Staff)



The List of Members Participate in the Project

NO.	Name	Name of assigned Committee or Group			
		Joint Committee	Coordinating Committee	Coordinating Sub-committee	Working Group
1	Mr. Riksh Syamananda	Chairman			
2	Mr. Ampol Senanarong				
3	Mr. Tanongchit Vongsiri		Chairman		Director
4	Mr. Damkhoeng Chandrapanya			Co-Chairmans	Assis.Dir.
5	Mr. Chak Chakkaphak				
6	Mrs. Dara Buangsuwon				
7	Mr. Vichitr Benjasil				
8	Representative of DTEC				
9	Rep. of Budget Bureau				
10	Rep.of Civil Service Commission				
11	Mr. Taketoshi Yoshiyama				Team Leader
12	Mr. Takeji Seino				
13	Mr. Teruhiko Nibe				
14	Mr. Makoto Kobayashi				
15	Mr. Katsusuke Arai				
16	Rep. of JICA Thailand Office				
17	Mr. Masaru Manabe	Mission			
18	Mr. Takao Tsukiboshi				
19	Mr. Yusaku Nagatomo				
20	Mr. Naoki Ando				
21	Mr. Vijai Nopamornbodi				
22	Mrs. Saranya Busparoek				
23	Mrs. Siriporn Sindhusake				
24	Mr. Arwooth Na Lampang				
25	Mrs. Srivai Singhagajen				
26	Mr. Narongsak Senanarong				
27	Mr. Pravat Tanboon-ek				
28	Mrs. Boonluck Seetanun				
29	Mrs. Pempoon Sarnthoy				
30	Mr. Amnuay Tongdee				
31	Mrs. Sunthree Niamglum				
32	Mr. Mitri Naevbanij				
33	Mr. Pimol Vuttisin				
34	Mr. Nitat Tangpinijkul				
35	Mr. Chaiwat Paosantadpanich				
36	Mr. Pramern Vesa-urai				
37	Mr. Prasop Thepayasuvan				
38	Mr. Somrak Noradechanon				
39	Mr. Sukapong Wayuparp				
40	Mr. Sompong Tongchuoy				
41	Mr. Veerawat Hinratanakul				
42	Mrs. Kanjana Bhudhasamai				
43	Miss Arunsri Vongurai				
44	Mr. Suparat Kositcharoenkul				

II. PROGRESS REPORT

JAPANESE SIDE

(TEAM LEADER)

PROGRESS REPORT (Japanese side)

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 V.-(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. (V - (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 (V - (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 (V - (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 (V -(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 (V - (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.

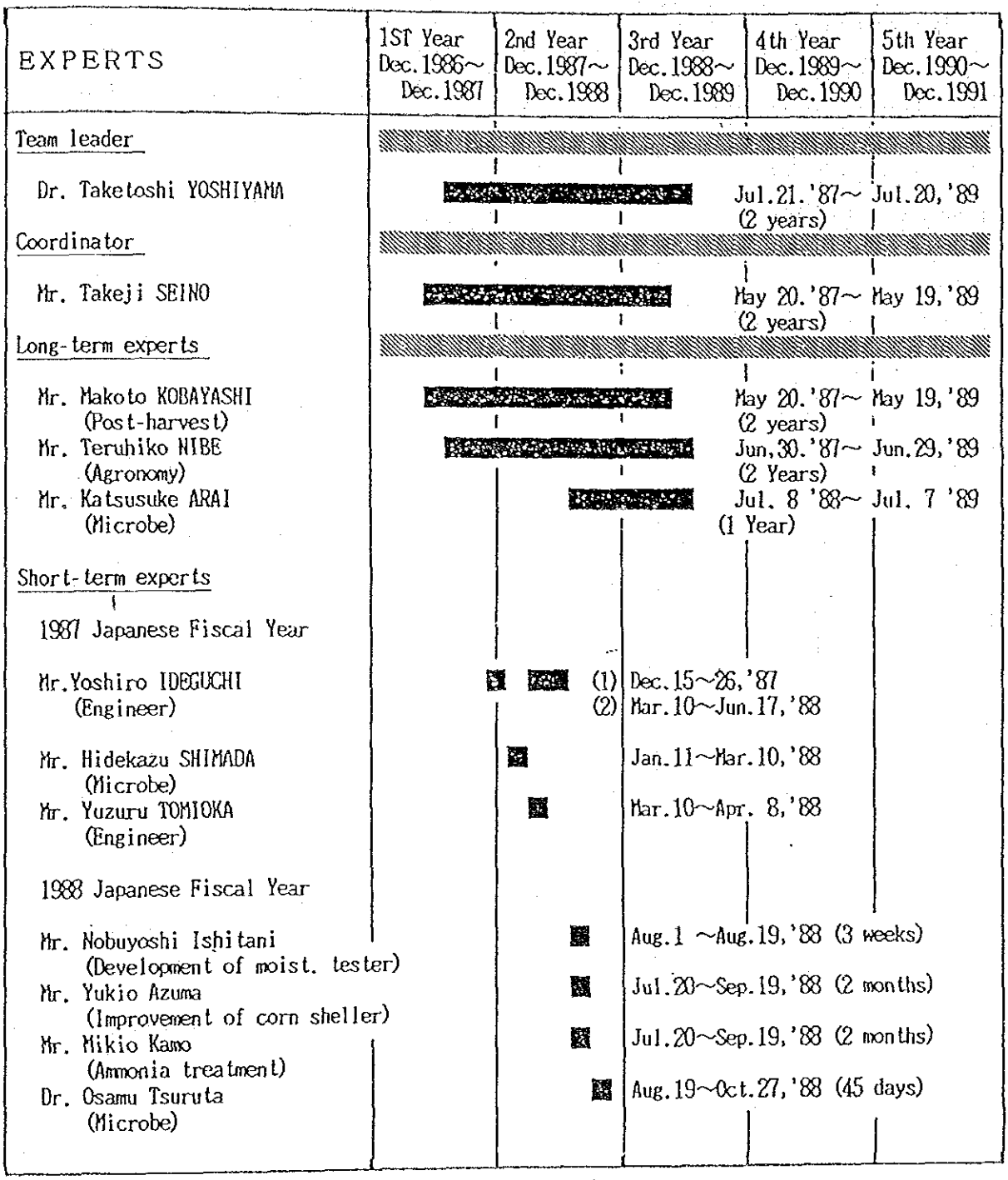
The total number of samples which need to be inspected by the Microbe Section is 1,941 this season. In order to inspect a lot of samples given by the other two sections, the Microbe Section suggests using a visual check method. This method would be able to treat many samples at one time. Basic analytical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



= plan, = assigned (MAIRCP)

Remark: Assignment of exparts in 1989 Japanese Fiscal Year will be informed by the Technical Guidance Team's summary report.

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 Crop Reseach 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. Sukapong Vayuparp (Field Crop Research Institute)		■ (Jun. 20 - Oct. 21)			
Dr. Maitri Naewbanij (Division of Agri. Engineering)		■ (Oct. 2 - Nov. 30)			
Dr. Vijai Nopamornbodi (Admistration)			■ (Mar. 6 - Mar. 24)		
1989 Japanese Fiscal Year					
(Division of Plant Pathology and Microbiology)			■	(3 months)	
(Field Crop Research Institute)			■	(3-5 months)	
(Division of Agri. Engineering)			■	(4 months)	
(Admistration)			■	(3-4 weeks)	
1990 Japanese Fiscal Year					

■ = attended ■ = scheduled

EQUIPMENT	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
1986 Japanese Fiscal Year					
General	¥ 5,100,000 (provided)				
1987 Japanese Fiscal Year					
1) General					
2) Agronomy		¥ 7,603,000			
3) Post-harvest		¥ 12,435,000			
4) Microbe		¥ 6,392,000 (provided)			
1988 Japanese Fiscal Year					
1) General					
2) Agronomy			¥ 42,500,000 (provided)		
3) Post-harvest					
4) Microbe					
1989 Japanese Fiscal Year				¥ 62,000,000 (demand)	
1990 Japanese Fiscal Year					
Total	¥ 5,100,000	¥ 26,430,000	¥ 42,500,000	¥ 62,000,000	

Local cost borne by Japan in Japanese fiscal year 1987, Baht 3,060,000.- for repairing water reservoir and in 1988, Baht 484,500.- for modification of the laboratory at Prabuddhabat Field Crops Experimantal Station

(HQIRCP)

III. SUMMARY REPORT

(JAPANESE TECHNICAL GUIDANCE TEAM)

SUMMARY REPORT OF THE JAPANESE TECHNICAL GUIDANCE TEAM FOR THE MAIZE QUALITY IMPROVEMENT RESEARCH CENTRE PROJECT

The Japanese Technical Guidance Team for the Maize Quality Improvement Research Centre Project (hereinafter referred to as "the Project") organized by Japan International Cooperation Agency, headed by Dr. Masaru Manabe, visited the Kingdom of Thailand and stayed for 12 days from March 7 to 18, 1989.
The purpose of the team was to review and consult on the present situation of the project activities, based on the Tentative Implementation Programme which was agreed at the Joint Committee Meeting on April 5, 1988.
During stay in Thailand, the team exchanged views and had discussions with the authorities concerned referring to the project activities.
This is the summary report related to the results of the discussions :

A. Research Activities

The main findings and assessments obtained by the three sections are summarized as follows :

1. Agronomy Section

1) Varietal Comparison of Maize Kernel Moisture and its Variation According to Different Times of Harvesting.
Code No. I-1-(1)-A, G (1988 - 1989)

Two composite varieties, Suwan 1, Suwan 2 and one hybrid variety KU 2602 were utilized for the study. Harvest was practiced at 35, 45 and 55 days after silking stage. Ears from every plot were measured for kernel moisture content for 30 days using a single kernel moisture meter. Yields of Suwan 1 and KU were higher than Suwan 2 at any harvesting time. Kernel moisture content of each variety measured for 30 days after harvesting decreased from 35% to 22%.

2) Long Term Study on the Relationship of the Environmental Conditions that Cause Aflatoxin Incidence in Maize.
Code No. I-1-(1)-B, E, G, J-(b) (1988 - 1992)

Planting was practiced ten times at two weeks interval from April to September. Rainfed and irrigated plots were planted at every planting.
The products were harvested at 105, 115 and 125 days after planting and kept under storage condition for 2 months.
Samples were taken at harvest and at two weeks interval from the stored product for analyzing aflatoxin.
Yields at earlier planting were higher than later planting, however, aflatoxin contents showed lower at the late planting. Difference was observed between rainfed and irrigated plots in yield.

3) Effects of Different Harvest Methods, Moisture Conditions and Storage Periods on Aflatoxin Contamination in Maize.
Code No. I-1-(1)-H, G (1988 - 1989)

Harvesting was done at 95, 105 and 115 days after planting, then the ears were stored for 2 months. Moisture measurement and aflatoxin analysis were made at harvest and during the storage period.

Small difference was observed between husked and unhusked on moisture content, however, aflatoxin level of unhusked plot was lower than husked plot. Although high level of aflatoxin was detected at 95 days, no aflatoxin was detected at 115 days.

4) Effects of Plant Density and Nitrogen Application on Aflatoxin Contamination.
Code No. I-1-(1)-D (1988 - 1989)

Three levels of plant density and four nitrogen levels were employed as treatments.

Significant difference in yield was observed among the plant densities, however, no difference among the nitrogen levels was observed.

5) Effect of Crop Rotation on Aspergillus spp. in the Soil.
Code No. I-1-(1)-C, B (1988 - 1990)

The combinations of maize with mungbean, soybean, peanut, sesame and sorghum were applied as crop rotations.

The population of Aspergillus flavus in the soil was counted before planting and after harvesting at every cropping.

The plots of mungbean and soybean following to maize showed lower population than the plot planted maize after maize, however, the differences were not significant.

2. Post-Harvest Section

1) Survey on the Present Situation of Farmers' and Middlemen's Post-Harvest Practices Regarding Maize in Thailand.
Code No. II-I-(2)-A (1987)

142 farmers and 32 middlemen in Nakhon Sawan, Petchaboon, Loei and Nakhon Ratchasima province were investigated to explore the relation between post-harvest practices and aflatoxin contamination at the end of 1987. The survey area was classified into three groups depending on the cultivator's behavior.

79 samples were extracted from fields, corn cribs or the storage facilities of merchants. Aflatoxin was detected in 21 samples, and there were differences of the degree of aflatoxin contamination among production areas and the storage durations.

2) Study on the Relation Between Types of Corn Sheller, Operational Conditions, Kernel Moisture Content and Aflatoxin Contamination in Maize.
Code No. II-1-(2)-B-(a) and (b) (1988 - 1989)

Four types of corn sheller were operated under various peripheral speed of cylinder drum with four levels of moisture content. (32%, 27%, 23% and 18% wb.) Then, occurrences of damage to grain and shelling efficiency were investigated.

The peripheral speed of the shelling drum had no effect on the broken kernel ratio in the applied range. On the other hand, the moisture content of kernels was closely correlated with the broken kernel ratio.

The average of aflatoxin contamination was gradual and low in the

early stage of storage, and related to initial moisture content of the kernels.

3) Ammonia Treatment of Maize to Control Aspergillus spp.and so Prevent Aflatoxin Contamination
Code No. II-3-(2)-C-(a)-(i) and (ii) (1988 - 1989)

Under this subject, three experiments were conducted.
a. A small scale experiment using high density polyethylene bottles was conducted to estimate the effective concentration level for preserving maize by ammonia treatment.
A.flavus was not detected in grain treated with ammonia.
b.& c. Ammonia treatment for ear and grain maize packed in gunny sacks was conducted individually to estimate the effect of ammonia regarding preservation of maize.
Ammonia treatment for maize effectively suppressed A.flavus activity. Fungus infestation other than A.flavus was present. During inspection on the day of completion of treatment, yeast and molds were observed and infestation increased during storage. Discoloration of the grain caused by the ammonia treatment was commonly observed in all three experiments.
It was suggested that the applying ammonia treatment will be able to control the aflatoxin contamination.

4) Improvement of Moisture Meter
Code No. II-2-(2) (1988 - 1989)

Calibration equations for the "Dole 400", "CTR-800 (single kernel moisture meter)" and "Grainer" moisture meters were formulated. However, the "Grainer" meter did not show linearity to the standard oven method. As a result, it was rejected as an object of our study.
The study to improve the standard oven method has not been completed.

3. Microbe Section

1) Studies on the Aflatoxin Content of Maize Cultivated under Different Conditions.
Code No. III-1-(1)-A & B (1988 - 1989)
Related Code. No. I-1-(1)-A ~ J

This subject was studied as a joint research project by the Microbe and Agronomy Sections.
In the subject No. 2. 3. 5 of Agronomy Section, the analytical method used to detect aflatoxin contamination were BGYF and TLC methods, and the inspection of fungus (A.flavus) in the soil samples were examined by the Agar method.
The results are reported in Agronomy Section.

2) Survey on the Present Situation of Farmers' and Middelmen's Post-Harvest Practices Regarding Maize in Thailand
Code No. I-1-(2)
Related Code No. II-1-(2)-A

This subject was studied as a joint research project by the Microbe and Post-Harvest Sections. In the subject No. 1 of Post-Harvest Section, the analytical method used to detect aflatoxin contamination was the TLC method, and the inspection of fungi (A.flavus) in the maize samples was examined by the agar method.
The results are reported in Post-Harvest Section.

3) Studies on the Aflatoxin Content in Maize Shelled by Different Types of Corn Sheller under Various Operating Conditions and Moisture Contents.
Code No. III-1-(2) (1988 - 1989)
Related Code No. II-1-(2)-B-(a) & (b)

This subject was studied as a joint research project by the Microbe and Agronomy Sections.
In the subject No. 2 of Post-Harvest Section, the analytical method used to detect aflatoxin contamination were the BGYF and TLC methods.
The results are reported in Post-Harvest Section.

4) Studies on the Effect of Ammonia Treatment for Prevention of Fungus Invasion of Ear and Grain Maize
Code No. II-1-(2) (1988 - 1989)
Related Code No. II-3-(2)-C-(a)-(i) & (ii)

This subject was studied as a joint research project by the Microbe and Post-Harvest Sections. In the subject No. 3 of Post-Harvest Section, the analytical methods used to detect aflatoxin contamination were the BGYF and TLC methods, and the inspection of fungi (A.flavus) in the maize samples examined by the visual inspection method.
The results are reported in Post-Harvest Section.

B. Tentative Plan for the Project Activities in the 1989 Japanese Fiscal Year

1. Assignment of Japanese Experts

The schedule for the dispatch of Japanese experts is shown in Annex II, of the Progress Report (Japanese side).

1) Long Term Experts

At present, five experts scheduled under the R/D and Tentative Schedule of Implementation (TSI) have been assigned. If a vacancy occurs, JICA will arrange to dispatch a successor, considering the smooth implementation of the project.

2) Short Term Experts

The short term experts requested for the project are listed below. JICA will dispatch the experts, considering the requests from Thailand, budget, and so on.

a) Development of moisture tester (2 months)
b) Improvement corn sheller (4 months)
c) Ammonia treatment (4 months)
d) Microbiology (Aspergillus spp.) (4 months)
e) Microbiology (Aflatoxin analysis) (3 months)
f) Improvement of drying method (4 months)
g) Simulation to clarify the relationship between corn yield and environmental factors (3 months)
h) Evaluation of insect damage and insect control (4 months)

2. Training of Thai Counterparts in Japan

The schedule for the training of Thai counterparts, is shown in Annex III, of the Progress Report (Japanese Side). The counterparts in the fields below are requested for training. JICA will accept the counterparts for training, considering the

requests from Thailand, budget, and so on.

a) Field Crop Research Institute (3 months)
b) Division of Agricultural Engineering (4 months)
c) Division of Plant Pathology and Microbiology (4 months)
d) Planning and Technical Division (two persons, 4 weeks)

3. Provision of Equipment

Equipment worth 62 million Yen will be requested for the project as shown in Annex IV, of the Progress Report (Japanese Side). JICA will provide the equipment, considering the request from Thailand, budget, and so on.

4. Research Plan

The main subjects which will be studied in the 1989 Japanese fiscal year are as follows:

Agronomy Section

1) Varietal comparison of maize kernel moisture and its variation according to different times of harvesting.
   Code No. I-1-(1)-A, G (1988 - 1989)
2) Long term study on the relationship of the environmental conditions that cause aflatoxin incidence in maize.
   Code No. I-1-(1)-B, E, G, I, J-(b) (1988 - 1992)
3) Effects of different harvest methods, moisture conditions and storage periods on aflatoxin contamination in maize.
   Code No. I-1-(1)-H, G (1988 - 1989)
4) Effects of plant density and nitrogen application on aflatoxin contamination.
   Code No. I-1-(1)-D (1988 - 1989)
5) Effect of crop rotation on Aspergillus spp. in the soil.
   Code No. I-1-(1)-C, B (1988 - 1990)
6) Effect of nitrogen regarding prevention of aflatoxin contamination by the inoculation method.
   Code No. I-1-(1)-D (1989 - 1990)
7) Identification of insects and the types of damage they inflict on the maize kernel.
   Code No. I-1-(1)-F (1989 - 1990)
8) Evaluation of insect damage that occurs under field conditions.
   Code No. I-1-(1)-F, B (1989 - 1991)
9) Relation between kernel type and resistance to fungus infection after inoculation.
   Code No. I-1-(1)-A (1989)
10) Relation between environmental factors and fungus infection.
   Code No. I-1-(1)-J-(b) (1989 - 1991)
11) Monitoring aflatoxin occurrence in the major maize production areas.
   Code No. I-1-(1)-J, I-3-(1)-A (1989 - 1991)

Post-Harvest Section

1) Study on the relation between types of corn sheller, mechanical damage and grain moisture content.
   Code No. II-1-(2)-B-(a) & (b), II-3-(2)-A (1988 - 1991)

2) Study on the relation between mechanical damage and aflatoxin contamination.
   Code No. II-1(2)-B-(a), (b) & (c) (1988 - 1989)
3) Moisture meter improvement 1 : Performance test of newly developed moisture meter for ear maize.
   Code No. II-2-(2) (1988 - 1989)
4) Moisture meter improvement 2 : Calibration of moisture meter.
   Code No. II-2-(2) (1988 - 1989)
5) Moisture meter improvement 3 : Study on standardization of the oven method in Thailand.
   Code No. II-2-(2) (1988 - 1989)
6) Ammonia treatment of maize to control Aspergillus spp. and so prevent aflatoxin contamination during storage.
   Code No. II-3-(2)-C-(a) (1988 - 1989)
7) Preliminary tests of trickle ammonia and trickle sulfur dioxide drying processes for maize.
   Code No. II-3-(2)-B-(b) (1988 - 1989)
8) Study on the effect of grading maize ears prior to shelling procedure.
   Code No. II-1-(2)-C-(a) (1989 - 1990)
9) Study on the improvement of storage facilities for farmers.
   Code No. II-3-(2)-C-(c) (1989 - 1991)
10) Study on simple drying methods.
   Code No. II-1-(2)-C-(c) (1989 - 1990)

The subject of Code No. II-1-(2)-C-(b) and II-3-(2)-C-(b) will be cancelled.

Microbe Section

1) Correlation between cultural practices and aflatoxin contamination.
   Code No. III-1-(1) A & B (1988 - 1991)
2) Correlation between post-harvest storage/processing and aflatoxin contamination.
   Code No. III-1-(2), III-3-(3)-A & B (1988 - 1990)
3) Physiological and ecological studies on A.flavus including the infection route.
   Code No. III-1-(3) (1988 - 1990)
4) Development of a simple and rapid analytical method for aflatoxin.
   Code No. III-2-(1)-A & B (1988 - 1990)
5) Studies on the water activity and the humidity equilibrium of Thai maize.
   Code No. III-1-(2) (1988 - 1990)

C. Others

1. Area Expansion of the Centre

The area expansion of the centre was requested from Thai side.

2. Medical Examination

In Japan, the mycotoxin researchers have medical examinations twice a year. Therefore, our team recommend that Thai authorities concerned provide the budget for Thai counterparts and temporary workers who join the aflatoxin research works to have medical examinations.

It is our pleasure to say that the relationship between Thai side and Japanese side is well established and the project runs successfully. We hope that both sides will continue mutual cooperation in order to promote this project. Lastly, we appreciate your kind cooperation during our stay in Thailand.

Research Implementation Plan

(March 1, 1989)

I T E M S	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			A-1),2),3),4),5),6), 7),8),9),10) & 11)		
(1)Correlation between cultural practices and aflatoxin contamination			M-1)		
(2)Correlation between post-harvest storage/processing and aflatoxin contamination			P-1),2),3) & 8) M-2) & 5)		
(3)Characteristics of Aspergillus flavus relating to aflatoxin contamination			M-3)		
2.Improvement of test technology			M-4)		
(1)Improvement of simple and rapid analytical methods of aflatoxin detection			P-3),4) & 5)		
(2)Improvement of simple moisture meter			A-2),3) & 5)		
3.Countermeasures to prevent aflatoxin			P-1),6), 7) & 9)		
(1)Improvement of cultivation practices			M-2)		
(2)Improvement of post-harvest practices					
(3)Aflatoxin prevention by controlling A. flavus					

Remark: Abbreviation of each section indicates as follows: A; Agronomy, P; Post-Harvest and M; Microbe.

The numbers with parenthesis regard as the subject numbers in "4. Research Plan".

ANNEX V.

IV. ABSTRACT OF THE EXPERIMENT RESULTS

(1989. 3)

THE MAIZE QUALITY IMPROVEMENT RESEARCH CENTRE PROJECT

I. Agronomy

Varietal Comparison of Maize Kernel Moisture and its Variation according to Different Times of Harvesting

Code No. I-1-(1)-A, G (1988)

Objectives

The object of the study is to examine the varietal characteristics on kernel moisture content shown at different times of harvesting. Moisture distribution as well as its variation by ear and by plot are also to be examined among the varieties.

Materials and Methods

Suwan 1, Suwan 2 and KU hybrid 2602 were utilized as varieties for the test. 35, 45 and 55 days after 50% silking were determined as the harvesting date.

Grain moisture and yield were observed at all harvests.

Moisture was determined by the calibrated oven method using a Juscon model, TM-5 moisture tester.

Three ears per plot were measured for kernel moisture every day from 35 days after 50% silking until 65 days using a single kernel moisture tester model CTR-800 made by Shizuoka Seiki CO.,Ltd., Japan.

General agronomical and varietal characteristics were observed during growth and at harvest time.

Plots were designed as split plots. Each plot was divided into a main plot and a sub plot. The main plots were used for the varietal tests while the sub plots were used for the harvest time tests, with three replications. Maize was planted eight rows per plot with a spacing of 75 cm. between rows and 50 cm. between hills.

Summary of the Results

Significant differences in yield between varieties were observed. However, there were no significant differences between harvest dates. Average yields of Suwan 1, Suwan 2 and KU 2602 were 984, 843.9 and 1139.9 kg/rai respectively. Yields between Suwan 1 and KU 2602 were not significantly different.

Kernel moisture measured for 30 days starting from 35 days after 50% silking are shown in the figures as sectional averages.

Analysis of the above results and moisture variations are being undertaken.

Problems

Many hours were required for measuring and processing data for single kernel moisture. Approximately 300,000 kernels were measured in 30 days.

Future Plans

The study must be continued to clarify more precisely the interpretation of moisture features in relation to agronomical characteristics such as germination, tasseling, silking and water supply etc.

A computerized single kernel moisture tester will has to be prepared to ease data processing and also another single kernel moisture tester is required next year.
Study of Aspergillus infection in tested varieties is planned as related work in the project.

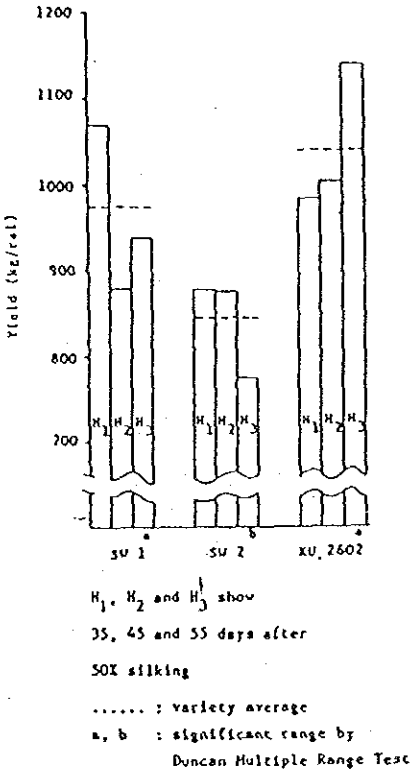


Fig.1 Yields of the three varieties

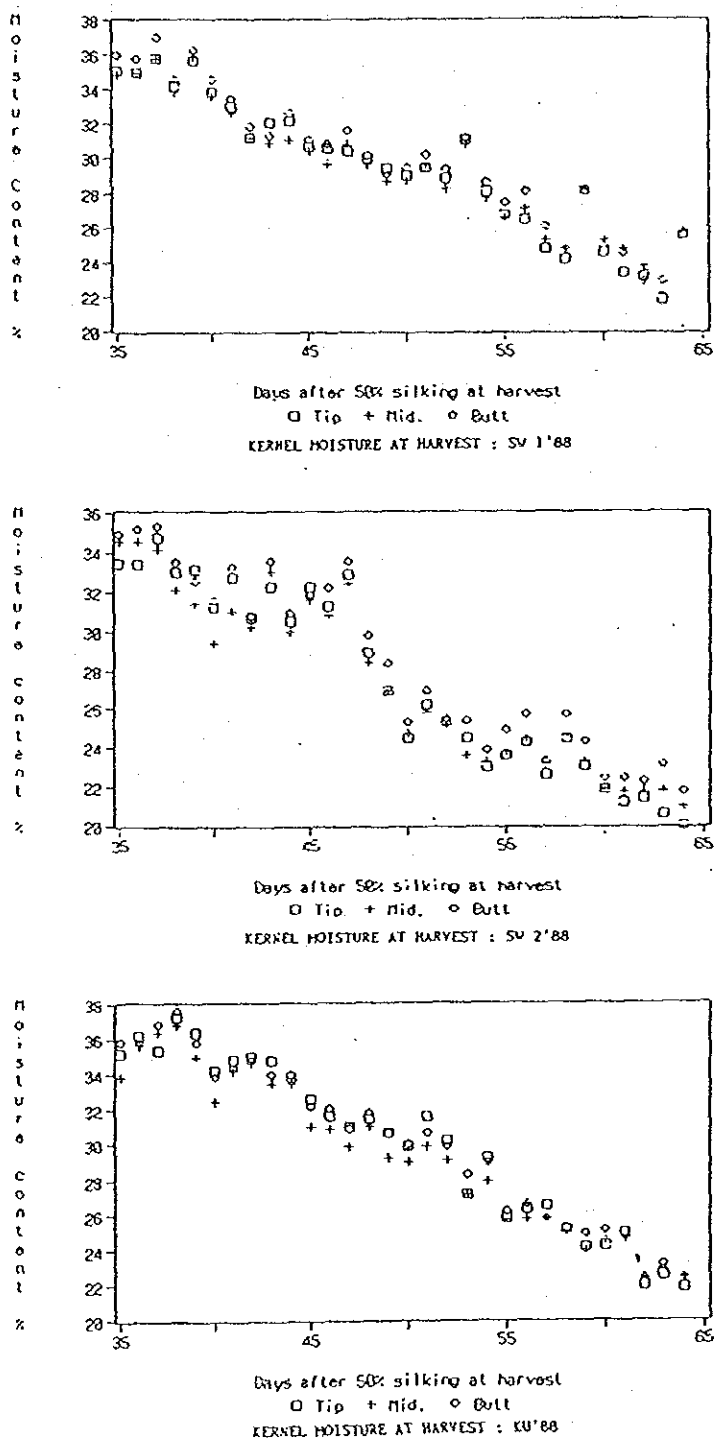


Fig.2 Moisture Content at Harvest

Study on the Relationship between Environmental Conditions and Aflatoxin Incidence in Maize
Code No. I-1-(1)-B, E, G, J-(b) (1988 - 1992)

Objectives
The object of the study is to clarify the relation between the environmental conditions and productivity and quality of maize.

Materials and Methods
Plots were treated by planting time and water supply. Planting was practiced ten times, every other week, from April 28 until September 1. Water supply was 1)rainfed and 2)adjusted irrigation. Irrigation was adjusted to supply water when the rainfall in the week was lower than the average rainfall over the last ten years. Adjustment was made to bring the water supply up to the same level.
Plot size was 12m. x 12m. Spacing was 75 cm. x 50 cm. with 2 plants per hill. Maize was harvested 105, 115 and 125 days after planting and then kept in store for 2 months. Samples for aflatoxin analysis were taken at harvest and every other week during storage.
The study will be carried out for five years.

Summary of the Results
The experiment is still in the field and the last harvest will be in early January.
Early planting in April and early May showed very good growth and yield due to good rainfall and its favourable distribution. After May, the rainfall became unfavorable and unstable.
Variation of the period of tasseling and silking occurred on time, although correlation with environmental factors has not yet been studied.
The relation between Aflatoxin incidence and time of planting is waiting for the result of analysis.

Problems
Some instruments such as the tensionmeter did not function properly.
Evaluation of insect damage was done by counting pin hole. It must be improved by collaborative work with an entomologist.

Future Plans
The study is to continue for another four years. Instruments to study environmental factors are to be improved next year.

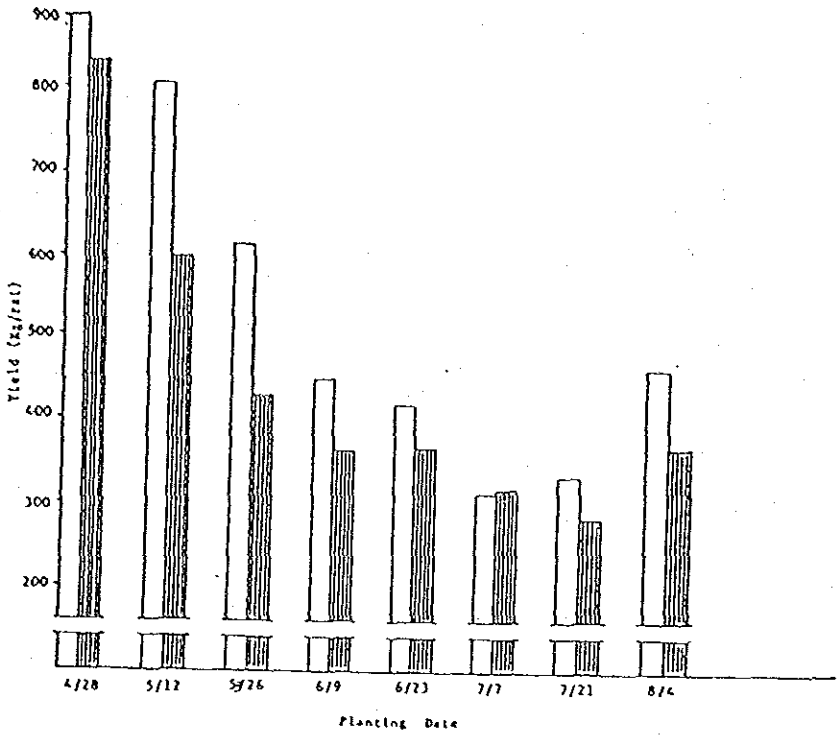


Fig.1 Relationship Between Planting Time and Average Yield

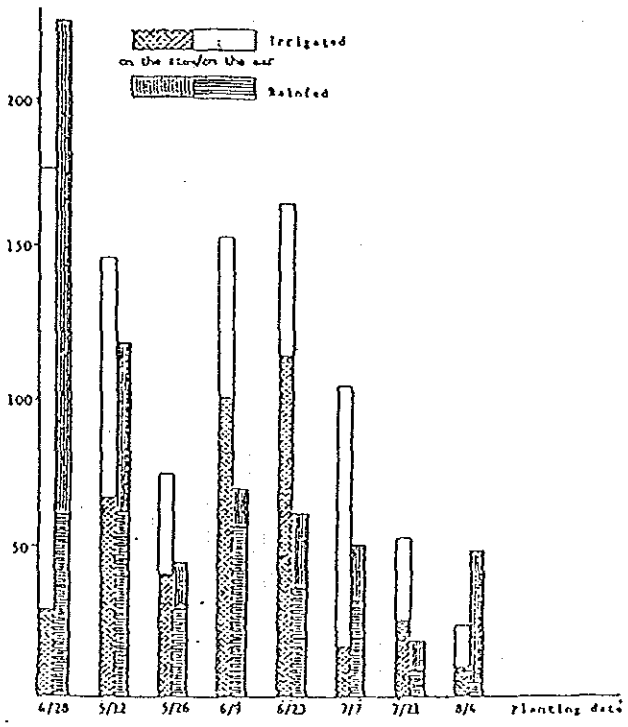


Fig.2 Insect Damage to the Ear Husk and Stem

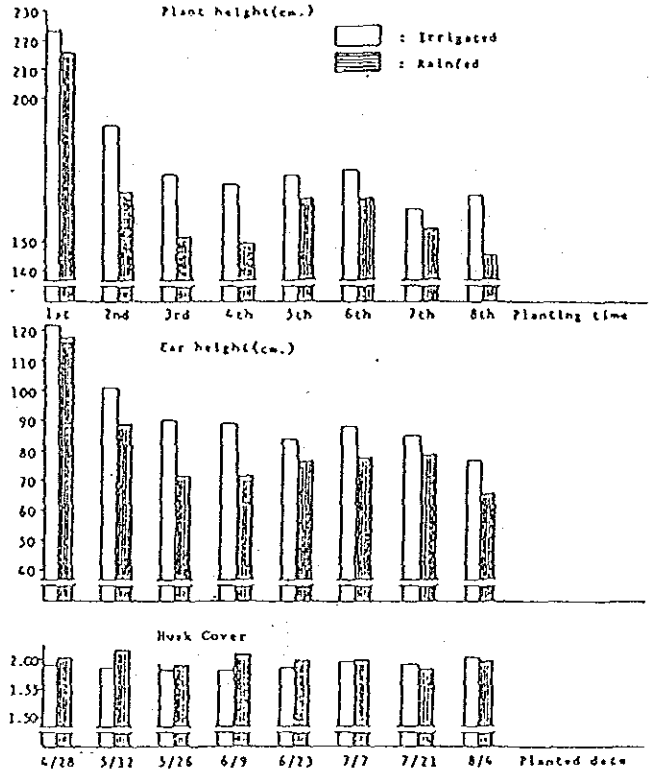


Fig.3 Morphologocal Characteristics in Relation to Planting Time

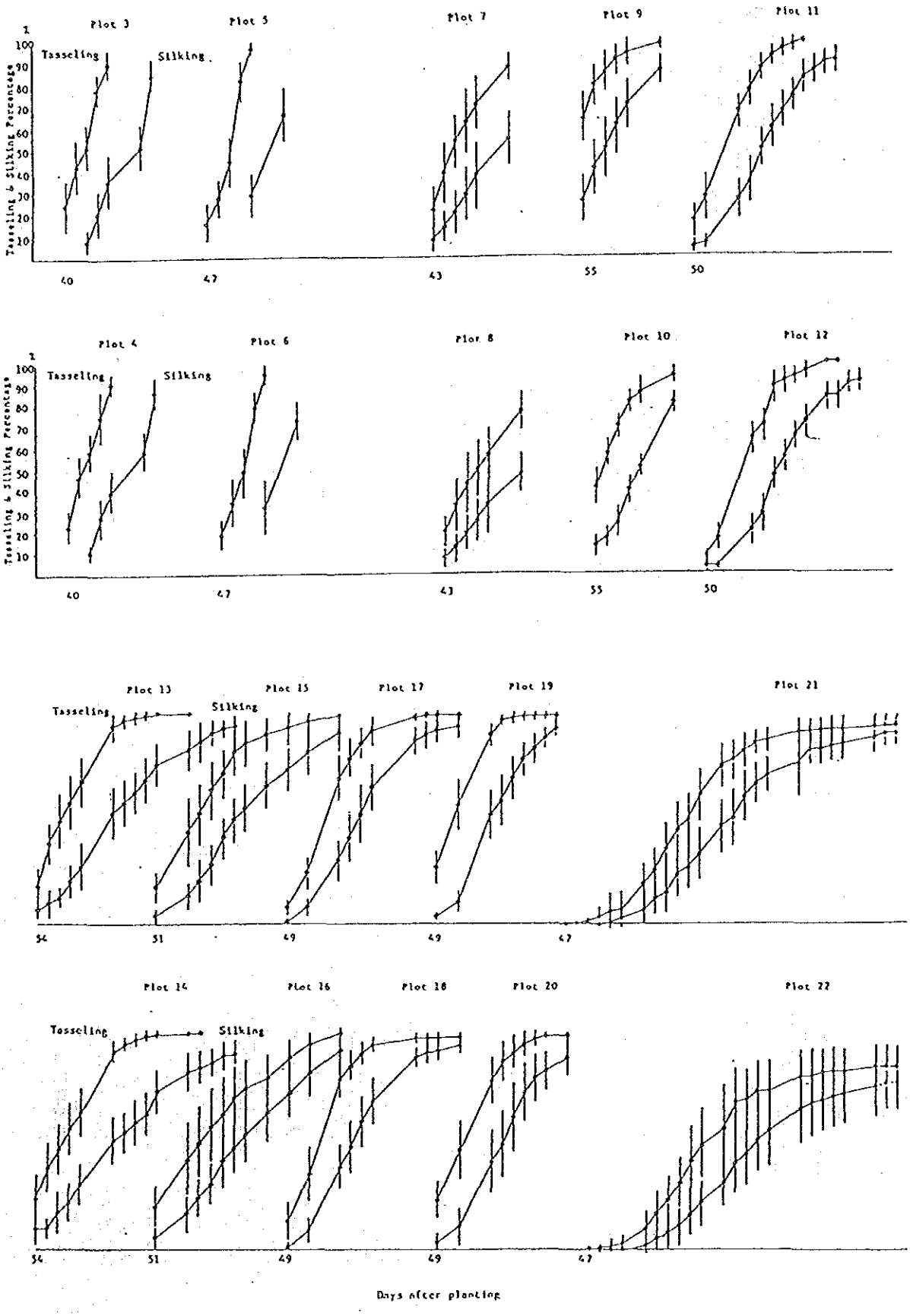


Fig.4 Time and Duration of Tasseling and Silking

Study on Effects of Harvesting Method, Harvesting Time and Storage Duration on Aflatoxin Occurrence in Maize
Code No. I-1-(1)-H, G (1988)

Objectives
The object of the study is to examine aflatoxin contamination by changing the methods of harvest and the time of harvesting.

Materials and Methods
The popular variety Suwan 1 was planted in a one rai plot. The conventional harvest method, removing the husk in the field, and harvesting with the husk for comparison were practiced at harvest time.
The time of harvest was at 95, 105 and 115 days after planting. Only standing plants were harvested.
Products were kept under storage conditions in the gunny bags for two months after harvest.
Samples were taken at harvest and at two week intervals for measuring moisture content and aflatoxin analysis.

Summary of Results
Grain moisture decreased about 3.8% in 10 days under field conditions. However, under storage conditions, moisture decreases at harvest of 95(H1), 105(H2) and 115(H3) days after planting showed only slight differences.
The average moisture under storage conditions 60 days after harvest fell from 31.3% to 18.7% for the first harvest, from 27.0% to 17.9% on the second harvest and from 23.7% to 15.2% for the third harvest.
Differences in moisture decreases during storage between without husks(Tr1) and with husks(Tr2) were observed to be 0.5% to 1.7% depending on harvest time. Analysis of aflatoxin occurrence is being undertaken.

Future Plans
The study is to be continued.

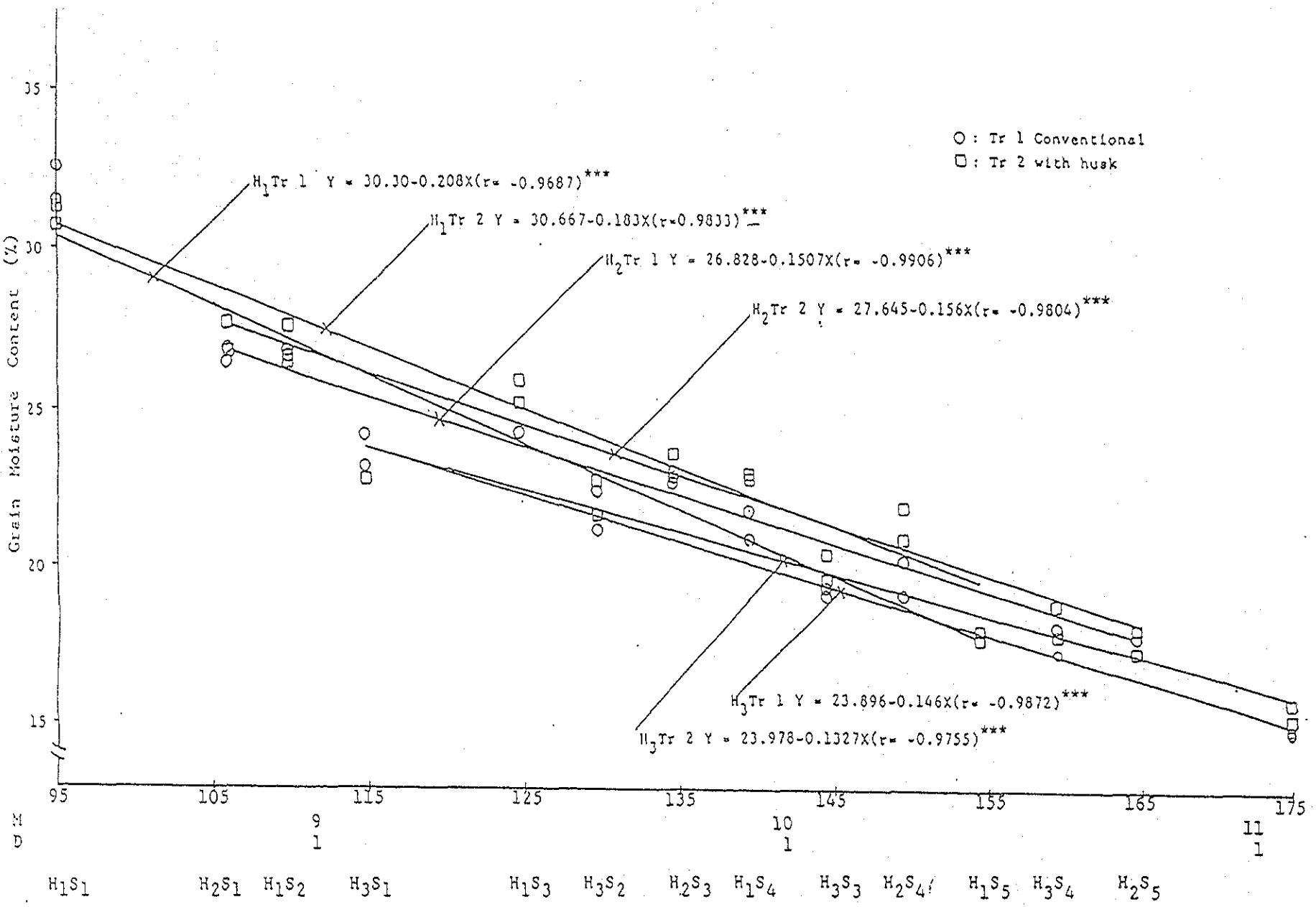


Fig.1 Relationship Between Moisture Content and Harvesting Methods

Effects of Plant Density and Nitrogen Application on Aflatoxin Contamination in Maize
Code No. I-1-(1)-D (1988 - 1989)

Objectives
The object of the study is to examine productivity and quality concerning aflatoxin contamination in relation to plant density and nitrogen application.

Materials and Methods
Three levels of plant density : 4266, 8533 and 12266 plants per rai and four levels of nitrogen application : 0, 10, 20 and 30 kg per rai were applied.
Maize was harvested at 105 days after planting and kept in storage for 2 weeks.
Grain samples for moisture measurement and aflatoxin contamination analysis were taken at harvest and two weeks after harvest.
Soil samples for analyzing fertility were taken before planting and after harvest.

Summary of Results
The average yield was 788.5 kg/rai. The effect of density was observed on the yield, however, the effect of nitrogen was not recognized. This is supposed to be due to the waterlogging that occurred in mid May to early June.
Aflatoxin contamination analysis and soil analysis are being undertaken.

Problems
In the at early growing stage, the experimental plot was subjected to a heavy rainstorm and waterlogging. Improvement of land levelling and effective drainage must be considered.

Future Plans
The study will be continued for 2 years. Wind velocity and light intensity will be measured during the growing period.

Effect of Crop Rotation on Aspergillus spp. in the Soil.
Code No. I-1-(1)-C, B (1988 - 1990)

Objectives
The object of the study is to examine the variations in a density of Aspergillus spp. in soil under various combinations of crop rotation with maize.

Materials and Methods
Crop rotations which form possible combinations with maize were considered as follows :

1. Maize + Soybean
2. Maize + Mungbean
3. Maize + Sorghum
4. Maize + Peanut
5. Maize + Maize
6. Soybean + Maize
7. Mungbean + Maize
8. Peanut + Maize
9. Sesame + Maize
10. Maize

Second crops were planted soon after the harvest of the first crops.
Soil samples to be examined for fungus density was taken before planting and after harvesting.

Summary of Results
In general, cropping during the early rainy season was observed to be better for any of the crops compared to the second cropping.
Soil fungus analysis is being undertaken in the project center. The matter should be discussed when the results are obtained.

Future Plans
The study will be continued next cropping season.

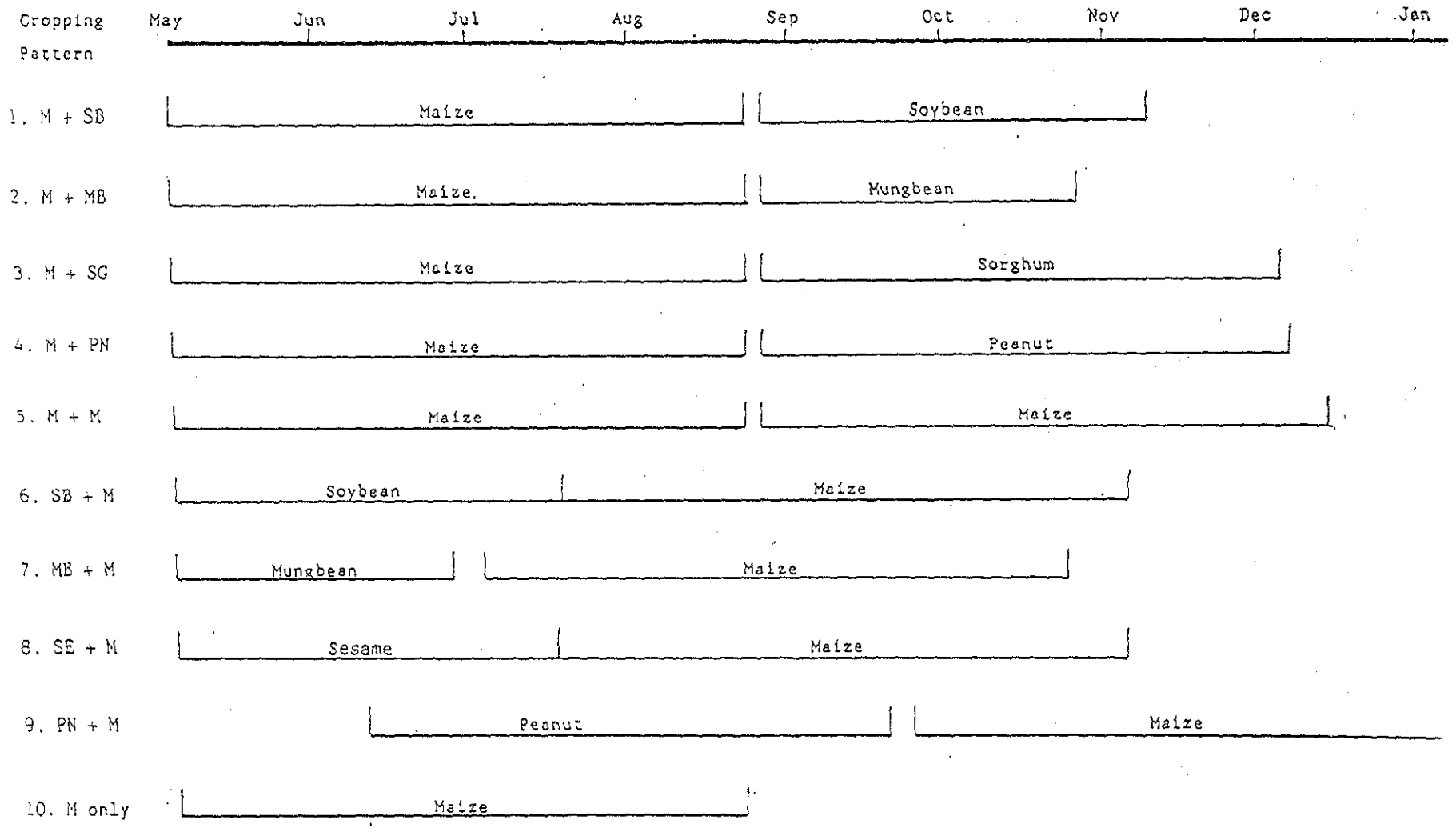


Fig.1 Crop Rotation Schedule

Ⅱ. Post-Harvest Studies

Survey on the Present Situation of Farmers' and Middlemen's Post-Harvest Practices Regarding Maize in Thailand

Code No. Ⅱ-1-(2)-A (1987)

Background and Objectives

To improve the quality of commodities and to develop techniques to accomplish this aim, it is important to understand the farmers' and middlemen's situation now and how it might be in the future.

The main objectives of this survey are (1) To collect general information about farmers and merchants in the main production areas, (2) To identify and clarify problems existing among the post-harvest practices of farmers and merchants related to aflatoxin contamination and (3) To investigate the factors that help produce of low aflatoxin contaminated maize if they exist.

Methods and Procedures

142 farmers and 32 middlemen were investigated in total, mainly by interview at the end of 1987. According to statistical data in 1987, 4 provinces typical of maize producing areas were selected, namely Nakorn Sawan, Petchaboon, Loei and Nakhorn Ratchasima provinces. From each province 1 or 2 Amphurs were selected. From each Amphur, 2 Tambons specializing in maize cultivation were selected depending on data provided by the relevant agricultural extension offices. From each Tambon, 4 villages, and from each village, 5 families were selected according to the recommendations of the staff in charge of the agricultural extension office in each Amphur. Corresponding to the survey areas for farmers, middlemen were selected according to the recommendations of the staff in charge of the agricultural extension office in each Amphur.

Samples for analysis were taken from the production fields, corn cribs, drying yard and/or merchants' stocks. Sample analysis was done by the project's Microbe Section.

Summary of the Results

① The survey areas were divided into 3 categories depending on their cultivation behaviour. The categories were, "no-2nd-crop area", "2-times-cropping area" and "2nd-crop-maize area". (Table 1)

② Drying was not a common procedure among farmers. 11.7% of farmers dried their products in drying facilities, and 16.1 % answered that they dried their product by piling it up in the fields. (Table 2) There was less price incentive to produce dry maize.

③ Farmer's storage facilities were classified into 5 categories. In "no-2nd-crop areas" all the farmers stored their maize an average of 51.4

days, while in the other areas 47.2% of the farmers stored their maize about 17 days.(Table 3)

④ The shelling procedure was done by a middleman's corn sheller in almost all cases. Ownership rate of a corn sheller by farmers was only 4.3%.

⑤ 45 samples were extracted from farmers' fields and storage facilities, and 34 samples were extracted from middlemen's drying fields and storage. Aflatoxin was detected in 21 samples, and there were differences among production areas, storage durations and aflatoxin contents.(Table 4 and 5)

⑥ Shelling damage done by corn shellers represented by crackage was only 0.33±0.34% among the samples from farmers.

⑦ One sample from plants standing in the field was infected by *A.flavus*. Then, about 43% of the samples collected within 10 days after harvest were infected by *A.flavus*.

Table 1 Cultivation Behaviour in the Survey Areas

Area or Amphur	1st Crop Maize			2nd Crop Maize	
	Total of Cultivation Area [A] (Rai)	Ratio of Maize in [A] (%)	Maize Harvested Area (%)	Ratio of Planted Area in [A] [B] (%)	Ratio of Maize in [B] (%)
No-2nd-crop : Amphur Lom kao (PB) [1] (except Mooban Kok Kra Tom)	29.8	88.5	84.8	2.8	0.0
2-times-cropping	42.3	85.5	55.8	65.1	0.0
Amphur Takh li (NS) [2]	49.7	91.5	38.8	60.0	0.0
Amphur Tak fa (NS)	39.2	87.2	32.3	57.2	0.0
Amphur Wichien buri (PB)	49.3	75.6	91.9	76.6	0.0
Amphur Lom kao (PB) (only Mooban Kok Kra Tom)	31.0	93.3	79.0	72.7	0.0
2nd-crop-maize	52.1	79.1	91.6	61.9	83.3
Amphur Wangsaphung (L)[3]	53.7	87.7	95.6	76.3	88.4
Amphur Pukradung (L)	51.5	82.2	85.2	42.2	77.8
Amphur Pakchong (NR)[4]	51.2	67.1	93.8	66.6	82.9
Average [5]	41.4	83.1	74.3	57.2	41.0

1: Petchaboon province.
2: Nakhorn Savan province.
3: Loei province.
4: Nakhorn Ratchasima province.
5: Weighted average.

Table 2 Drying Practices

Area	Sun Drying				No Dry	No Answer
	In Field[1]		On Drying Floor			
	(%)	Day(s)	(%)	Day(s)	(%)	(%)
No-2nd-crop	0.0	—	0.0	—	100.0	0.0
2-times-cropping	2.9	1.0	19.1	2.4	73.5	4.4
2nd-crop-maize	34.4	3.7	6.6	8.3	59.0	0.0
Average[2]	16.1	2.1	11.7	4.7	70.1	2.0

1: Piled up in the field for natural drying.
2: Weighted average.

Table 3 Types and Duration of Storage

Area	Proportion of Storage Owner (%)	Types of Storage		Material Used for the Floor		Storage Duration[2]
		Type[1]	(%)	Materials	(%)	Days
No-2nd-crop	100.0	A-1	20.0	Wood	26.7	51.4
		A-2	80.0	Bamboo	73.3	(51.4)
		A-3	0.0	Concrete	0.0	
		B-1	0.0	Ground	0.0	
		B-2	0.0	Others	0.0	
2-times-cropping	95.3	A-1	34.4	Wood	75.0	17.3~
		A-2	32.8	Bamboo	3.1	(27.4)
		A-3	16.4	Concrete	14.1	
		B-1	8.2	Ground	6.2	
		B-2	8.2	Others	1.6	
2nd-crop-maize	73.8	A-1	37.8	Wood	70.2	17.6
		A-2	48.9	Bamboo	17.0	(21.6)
		A-3	0.0	Concrete	4.3	
		B-1	4.4	Ground	8.5	
		B-2	8.9	Others	0.0	
Average	89.7					27.6 (33.5)

1. Types of storage were defined as follows;
   A-1: Elevated floor corn crib
   A-2: Non-elevated floor corn crib
   A-3: Grounded corn crib
   B-1: Under house storage with elevated floor
   B-2: Under house storage with non-elevated floor
2. The figures in parentheses indicate the storage duration in the case of maize kept by farmers in corn cribs.

Table 4 Origin of, Information on and Analytical Caracteristics of the Samples Form Farmers

(1) 1st Crop Maize

No	Area			Ear [4] or Grain	Storage Duration		MC by Dole -400	Shelling Method[5]	Quality of the Samples [6]						Shelling Damage	Germination Rate	*A.flavus* Infect Rate[7]	Aflatoxin B_1 Content
	Province [1]	District[2]	Category[3]		Ear	Grain			Undamaged Kernel	Damaged Kernel				Immature				
										Broken	Mold	Insect	Total					
				(E/G)	Day(s)	Day(s)	(%)	(H/M)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(ppb)
1	NS	TL	2C	E	15	--	18.0	H	100.0	0.0	0.0	0.0	0.0	0.1	0.0	97.0	2.0	0
2	NS	TL	2C	E	10	--	20.8	H	99.8	0.0	0.2	0.0	0.2	0.1	0.0	95.5	0.0	0
3	NS	TL	2C	E	30	--	14.3	H	95.1	0.0	2.0	0.0	2.0	2.9	0.0	92.5	0.5	0
4	NS	TL	2C	E	7	--	19.3	H	95.3	0.4	1.4	0.0	1.8	0.1	0.4	98.5	3.0	0
5	NS	TL	2C	E	7	--	21.7	H	88.3	0.0	10.2	0.5	10.7	0.1	0.0	91.5	0.0	0
6	NS	TF	2C	E	20[8]	--	16.2	H	63.1	0.0	35.7	0.0	35.7	0.4	0.0	97.0	1.5	344
7	NS	TF	2C	E	30[8]	--	14.3	H	99.4	0.0	0.7	0.3	1.0	0.1	0.0	93.5	0.0	0
8	NS	TF	2C	G	21	14	11.8	M	97.3	1.0	0.8	0.3	1.9	0.5	1.0	88.5	20.5	665
9	NS	TF	2C	E	1	--	23.3	H	98.8	0.0	0.8	0.0	0.8	0.4	0.0	38.0	0.0	0
10	NS	TF	2C	E	20	--	12.7	H	98.1	0.0	0.2	0.2	0.4	0.8	0.0	98.0	0.0	0
11	NS	TF	2C	E	20	--	12.7	H	96.8	0.0	0.8	0.3	1.1	1.2	0.0	99.0	0.0	0
12	NS	TF	2C	E	10	--	15.2	H	96.4	0.6	1.2	0.3	2.1	1.4	0.8	98.5	1.0	0
13	PB	LK	2C	G	30	30	16.5	M	97.6	0.0	1.7	0.0	1.7	0.5	0.0	98.5	2.0	0
14	PB	LK	N2	G	30	0	14.2	M	91.5	0.5	0.7	6.8	8.3	0.1	0.5	89.5	1.5	0
15	PB	LK	N2	G	30	20	13.2	M	97.8	0.5	1.0	0.8	2.1	0.1	0.5	NA [9]	0.5	0
16	PB	LK	N2	E	105	--	12.5	H	92.5	0.2	2.5	4.8	7.3	0.2	0.2	99.0	6.5	337
17	PB	LK	N2	G	30	10	14.3	M	97.8	0.0	1.5	0.0	1.5	0.3	0.0	93.0	0.0	0
18	PB	LK	N2	G	100	7	13.0	M	80.9	0.3	8.1	9.0	17.4	0.3	0.3	68.5	1.5	0
19	PB	LK	N2	G	35	7	14.4	M	94.9	0.1	0.0	4.2	4.3	0.0	0.1	96.0	1.5	0
20	PB	LK	N2	G	75	7	13.3	M	96.4	0.2	1.9	0.4	2.5	1.1	0.2	96.0	1.5	0
21	PB	WB	2C	G	30	45	18.0	M	83.2	0.6	7.3	9.1	17.0	0.1	0.6	40.0	20.0	139
22	PB	WB	2C	E	90	--	12.0	H	95.8	0.0	3.8	0.3	4.1	0.1	0.0	90.5	6.0	600
23	PB	WB	2C	G	90	3	11.7	M	96.7	0.6	3.8	0.2	4.6	1.3	0.8	88.5	7.0	82

(Continued)

No	Area			Ear [4] or Grain	Storage Duration		MC by Dole -400	Shelling Method[5]	Quality of the Samples[6]						Shelling Damage	Germination Rate	*A.flavus* Infect Rate[7]	Aflatoxin B_1 Content
	Province [1]	District[2]	Category[3]		Ear	Grain			Undamaged Kernel	Damaged Kernel				Immature				
										Broken	Mold	Insect	Total					
				(E/G)	Day(s)	Day(s)	(%)	(H/M)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(ppb)
24	LOEI	WP	2M	G	30	20	15.9	M	90.9	0.0	3.5	5.6	8.1	0.0	0.0	67.5	15.5	71
25	NR	PC	2M	E [10]	21	--	14.6	H	100.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0

(2) 2nd Crop Maize

No	Area			Ear [4] or Grain	Storage Duration		MC by Dole -400	Shelling Method[5]	Quality of the Samples[6]						Shelling Damage	Germination Rate	*A.flavus* Infect Rate[7]	Aflatoxin B_1 Content
	Province [1]	District[2]	Category[3]		Ear	Grain			Undamaged Kernel	Damaged Kernel				Immature				
										Broken	Mold	Insect	Total					
				(E/G)	Day(s)	Day(s)	(%)	(H/M)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(ppb)
1	LOEI	WP	2M	E	0 [9]	--	14.3	H	97.8	0.0	0.0	2.1	2.1	0.3	0.0	99.5	0.0	0
2	LOEI	WP	2M	E	0	--	19.0	H	93.8	0.0	4.5	0.1	4.6	0.3	0.0	97.5	0.0	0
3	LOEI	WP	2M	G	15	1	17.0	M	97.5	1.2	0.0	0.3	1.5	0.6	1.2	98.5	2.5	0
4	LOEI	WP	2M	E	20	--	16.8	H	88.3	0.0	7.5	5.3	12.8	0.8	0.0	100.0	0.0	0
5	LOEI	WP	2M	G	2	14	16.6	M	98.5	0.3	0.2	0.2	0.7	0.8	0.3	100.0	0.0	0
6	LOEI	WP	2M	E	2	--	15.1	H	99.2	0.0	1.6	0.0	1.6	0.4	0.0	99.0	2.5	0
7	LOEI	WP	2M	E	0 [9]	--	14.1	H	99.1	0.0	0.2	0.0	0.2	0.5	0.0	100.0	0.0	0
8	LOEI	WP	2M	E	0 [9]	--	22.2	H	98.2	0.5	1.0	0.0	1.5	0.1	0.5	90.5	0.0	0
9	LOEI	WP	2M	E	0 [9]	--	16.2	H	97.9	0.0	0.9	0.0	0.9	0.0	0.0	21.0	1.0	0
10	LOEI	PD	2M	E	3	--	14.6	H	98.4	0.0	0.8	0.3	1.1	0.3	0.0	54.5	1.0	0
11	LOEI	PD	2M	E	0 [9]	--	14.7	H	97.8	0.5	0.5	0.0	1.0	0.3	0.5	31.0	0.0	0
12	LOEI	PD	2M	G	14	2	16.7	M	99.2	0.0	0.0	0.4	0.4	0.4	0.0	98.0	0.0	0

(Continued)

No	Area			Ear [4] or Grain	Storage Duration		MC by Dole -400	Shelling Method[5]	Quality of the Samples [6]						Shelling Damage	Germination Rate	*A.flavus* Infect Rate[7]	Aflatoxin B_1 Content
	Province [1]	District[2]	Category[3]		Ear	Grain			Undamaged Kernel	Damaged Kernel				Immature				
										Broken	Mold	Insect	Total					
				(E/G)	Day(s)	Day(s)	(%)	(H/M)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(ppb)
13	NR	PC	2M	E	6	--	14.6	H	95.4	0.0	3.5	0.0	3.5	0.5	0.0	85.0	0.5	0
14	NR	PC	2M	E [11]	6	--	10.9	H	10.4	0.0	89.8	0.0	89.8	0.0	0.0	10.0	0.0	0
15	NR	PC	2M	E	5	--	19.8	H	99.5	0.1	0.0	0.0	0.1	0.0	0.1	100.0	0.0	0
16	NR	PC	2M	E	0	--	12.4	H	98.9	0.0	0.3	0.2	0.5	0.2	0.0	99.5	0.0	0
17	NR	PC	2M	G	10	10	17.0	M	98.2	0.0	1.5	0.2	1.7	0.2	0.0	98.5	1.0	0
18	NR	PC	2M	E	0	--	16.8	H	86.1	0.2	13.2	0.1	13.3	0.4	0.2	88.5	0.0	0
19	NR	PC	2M	E	2	--	19.1	H	99.0	0.0	0.5	0.0	0.5	0.1	0.0	97.0	8.0	0
20	NR	PC	2M	E	2	--	15.1	H	98.6	0.0	0.3	0.0	0.3	0.0	0.0	98.5	0.0	0

1: NK; Nakhorn Sawan, PB; Petchaboon and NR; Nakhorn Ratchasima

2: TL; Tak li, TF; Tak fa, LK; Lom kao, WB; Wichienburi, WP; Wangsaphung, PD; Pukradung and PC; Pakchong

3: 2C; 2times-cropping area, N2; No-2nd-crop area and 2M; 2nd-crop-maize area

4: E and G indicate ear maize and shelled maize, respectively.

5: H and M indicate hand shelled and mechanically shelled, respectively.

6: Each sample inspected was 100 gr.

7: 200 kernels.

8: Not available.

9: Sample extraction had been during harvesting or from plants standing in the field.

10: Farmer selected a "good" ear from his product and kept it in his house.

11: Same lot as number 13 sample, but farmer gave selection of his product. Number 14 sample was selected as a "bad" ear.

Table 5 Origin of, Information on and Analytical Characteristics of the Samples From Middlemen

No	Area		Storage Duration		Drying Practiced by Middleman	Storage Conditions	MC by Dole-400	Quality of the Samples[6]						Germination Rate	*A.flavus* Infect Rate[7]	Aflatoxin B_1 Content
	Province[1]	District[2]	Ear	Grain				Undamaged Kernel	Damaged Kernel				Immature			
									Broken	Mold	Insect	Total				
			Day(s)	Day(s)	Day(s)		(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(ppb)
1	NS*	TL	14	7	2	Gunny sack	14.3	97.0	1.0	0.9	0.0	1.9	0.9	91.5	15.5	71
2	NS*	TL	NA	12	0	Gunny sack	15.2	92.0	0.2	1.8	4.8	6.8	0.5	88.5	8.5	0
3	NS	TL	NA	60	0	Piled,covered at night	12.8	89.3	0.8	8.8	2.4	10.0	0.3	70.0	14.5	743
4	NS	TL	NA	0	5	Drying	13.7	82.8	2.8	4.7	8.8	16.3	0.3	84.5	5.0	0
5	NS	TL	NA	0	6	Drying	15.2	82.4	2.1	12.5	1.4	16.0	1.0	78.5	7.0	77
6	NS*	TL	NA	25	5	Gunny sack	12.4	92.8	1.2	4.4	0.4	6.0	1.1	78.5	8.5	117
7	NS*	TL	NA	0	6	Finished drying, piled	12.8	92.9	2.3	2.6	0.9	5.8	1.1	81.0	5.5	0
8	NS	TF	NA	30	0	Gunny sack	14.0	95.5	0.7	1.8	0.0	2.3	1.9	88.5	0.0	0
9	NS	TF	NA	NA	NA	Piled,described "bad"	12.4	71.4	2.1	22.2	3.0	27.3	0.3	14.5	43.5	648
10	NS	TF	NA	0	0	Gunny sack	15.3	79.2	0.4	16.0	3.4	19.8	0.0	54.0	3.5	387
11	NS*	TF	NA	7	3	Piled inside storage	15.0	86.6	2.1	8.7	1.0	11.8	0.8	62.5	25.5	1,060
12	NS*	TF	NA	0	3	Drying	13.6	80.3	2.7	10.0	1.7	14.4	0.3	65.0	88.0	397
13	NS*	TF	NA	7	3	Piled outside storage	13.6	76.6	1.9	18.1	1.9	21.9	0.4	63.0	7.0	875
14	PB*	LK	NA	17	3	Piled inside storage	15.2	83.3	0.4	4.3	10.4	15.3	0.1	86.5	4.5	0
15	PB*	LK	NA	7	3	Piled outside storage	14.6	84.1	0.5	2.7	12.3	15.5	0.2	86.0	4.0	354
16	PB	LK	45	7	0	Gunny sack	14.0	91.4	0.2	1.9	5.0	7.1	0.8	92.5	5.0	105
17	PB	LK	60	7	0	Gunny sack	14.7	84.4	1.3	4.3	7.4	13.0	2.2	94.5	3.0	0
18	PB	LK	45	1	0	Gunny sack	14.3	83.5	0.3	3.5	12.1	15.9	0.3	87.5	3.5	0
19	PB	LK	60	1	0	Gunny sack	12.5	63.7	0.5	5.8	29.1	35.4	0.5	78.5	7.5	0
20	LOEI	WP	NA	NA	NA	Gunny sack	12.1	93.4	0.6	3.4	1.7	5.7	0.3	91.0	4.5	74
21	LOEI	WP	NA	1	0	Gunny sack	15.0	96.0	0.8	0.9	0.9	2.6	0.6	98.5	1.5	66
22	LOEI	WP	NA	1	0	Gunny sack	14.1	96.0	1.4	0.2	0.7	2.5	0.8	95.0	2.0	0
23	LOEI	WP	30	60	0	Gunny sack	13.5	73.1	0.3	1.6	24.8	26.5	0.7	12.5	6.0	0
24	LOEI	WP	NA	1	0	Gunny sack	16.2	98.7	0.1	0.1	0.2	0.4	0.3	98.5	0.0	0

(Continued)

No	Area		Storage Duration		Drying Practiced by Middleman Day(s)	Stoage Conditions	MC by Dole -400 (%)	Quality of the Samples[6]						Germination Rate (%)	*A.flavus* Infect Rate[7] (%)	Aflatoxin B_1 Content (ppb)
	Province[1]	District[2]	Ear Day(s)	Grain Day(s)				Undamaged Kernel (%)	Damaged Kernel				Immature (%)			
									Broken (%)	Mold (%)	Insect (%)	Total (%)				
25	LOEI	PD	0	3	0	Gunny sack	12.8	97.1	0.1	0.5	0.4	1.0	1.3	88.5	2.0	0
26	LOEI	PD	0	7	0	Gunny sack	17.8	94.3	0.5	2.4	0.4	3.3	0.7	88.5	1.5	0
27	LOEI	PD	NA	7	2	Gunny sack	15.9	98.6	0.7	0.7	0.0	1.4	0.3	85.5	1.5	0
28	PB	WB	90	3	0	Gunny sack	13.0	91.1	0.0	7.9	0.2	8.1	0.4	89.5	0.5	0
29	PB	WB	60	1	0	Gunny sack	13.5	78.8	0.0	10.4	2.7	13.1	0.0	0.0	12.5	423
30	PB[V]	WB	60	2	0	Gunny sack	12.0	82.5	0.9	10.6	5.0	16.5	0.3	81.0	7.0	0
31	PB[V]	WB	0	2	0	Gunny sack	13.8	96.5	0.2	1.6	0.7	2.5	0.6	0.0	1.5	0
32	PB	WB	NA	45	0	Gunny sack	13.8	86.4	0.4	7.7	4.1	12.2	0.6	82.5	6.5	0
33	NR	PC	NA	10	1	Gunny sack	14.5	92.9	0.9	4.8	0.5	6.2	0.7	90.5	2.5	0
34	NR	PC	NA	3	1	Gunny sack	15.9	93.9	0.9	3.7	0.3	4.9	0.5	94.0	0.5	0

Study on the Relation Between Types of Corn Sheller, Operational Conditions and Aflatoxin Contamination in Maize
Code No.: II-1-(2)-B-a) and II-1-(2)-B-b) (1988 ~1989)

Background and Objectives

Mechanical damage to grain might be supposed to be one of the most important causes of infection in maize by *A.flavus,* an aflatoxin producing fungus. The shelling process is important in the post-harvest procedure, and almost all of this process has already been mechanized in Thailand. This study is intended to clarify the relation between type of corn sheller, kernel moisture content, occurrence of mechanical damage to kernels and aflatoxin contamination, and then to give a contribution on corn sheller improvement.

Methods and Procedures

Four types of corn sheller; namely, the plate tooth cylinder type ("LOTUS 77", Thailand), the rasp bar cylinder type with special rubber (ALVAN BRANCH, England), the spike tooth type ("NCR-1200", Japan) and the disc type (CHIKUMA, Japan), were tested.

Variable factors were the peripheral speed of the cylinder drum and the kernel moisture content. Factors other than these two were constant. Proposed kernel moisture contents were 32, 27, 23 and 18 % (wb). It was intended that preparation of these was to be accomplished in the field from which the sample came. The peripheral speed of the cylinder drum was set at three or four levels according to the results of performance tests and the standard drum speed of each machine.

Occurrences of damage to grain and shelling efficiency were investigated using grain maize produced from approximately 400 kg of ear maize sample selected for each treatment. For four weeks consecutively after shelling, shelled maize samples were stored under ambient air conditions, and during the storage period, samples for quantitative analysis of aflatoxin content were extracted on the 0, 1, 3, 7, 14, 21 and 28th day. Sample analysis was done by the project's Microbe Section.

Summary of the Results

① The peripheral speed of the shelling drum was given no effect regarding on the broken kernel rate in the applied range. (Fig.1) But, for shelling efficiency there was a tendency towards improvement as peripheral speed increased. (Fig.2)

② Moisture content of kernels was deeply correlated with the broken kernel ratio.(Fig.3) For the "LOTUS 77" and "NCR-1200", an inflection point of the broken kernel ratio appeared at around 23% kernel moisture content. (Table 6)

③ The "CHIKUMA" sheller showed the lowest broken kernel ratio, but shelling efficiency was extremely low. For example, it was not able to shell about 41% of kernels by weight in the case of 32% m.c..

④ Grain temperature during storage did not change in the case of 18% m.c., while that of the other moisture contents increased to more than 60℃ in some cases.

⑤ Kernel moisture contents decreased during storage. Final moisture contents 28 days after shelling were approximately 20%, 20%, 19% and 17% corresponding to the initial moisture contents 32%, 27%, 23% and 18%, respectively.

⑥ Aflatoxin contents decreased as the initial moisture contents of samples decreased except in the case of 23% m.c.. The relation between the damaged kernel ratio and aflatoxin contamination was not clear for each moisture content.(Fig.4)

View to the Next Year

From this year's results, the relation between the broken or injured kernel ratio and aflatoxin contamination was not clarified. Investigation is to be continued. Also, the relation between moisture content and aflatoxin contamination needs to be examined because the highest aflatoxin content during storage was detected in the 23% moisture content samples. The relation between moisture content and optimum harvest time, minimum mechanical damage during shelling, maximum shelling efficiency and inhibition of fungus growth, also requires more study. Further, the maximum safe delay between harvest and shelling needs to be investigated as does the best processing method in order to control aflatoxin contamination.

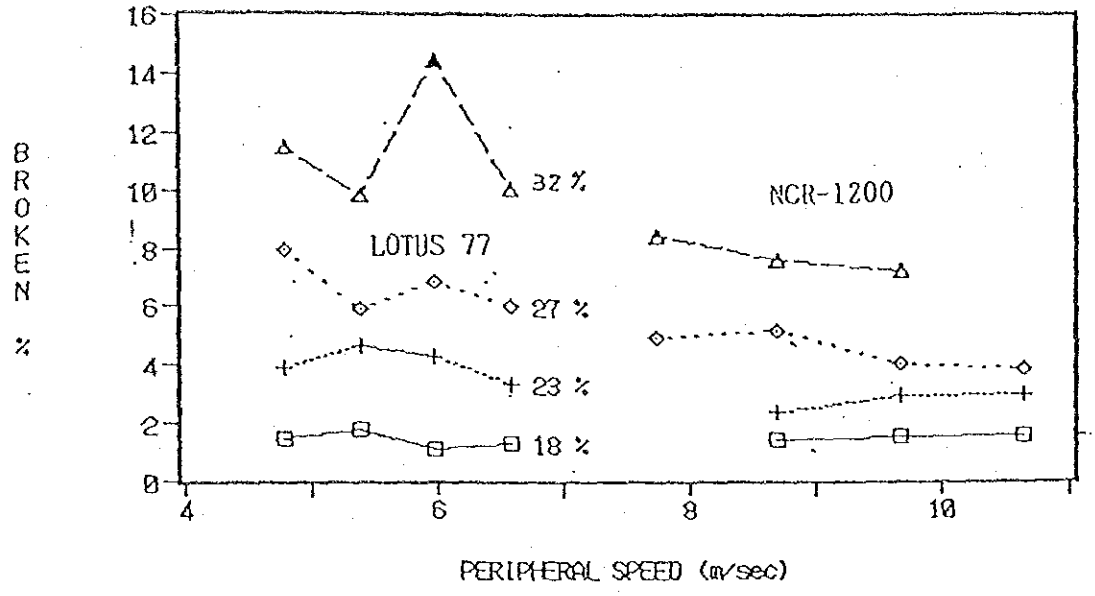


Fig.1 Relation Between Peripheral Speed of Shelling Drum and Broken Kernel Ratio of the "LOTUS 77" and "NCR-1200" Corn Sheller

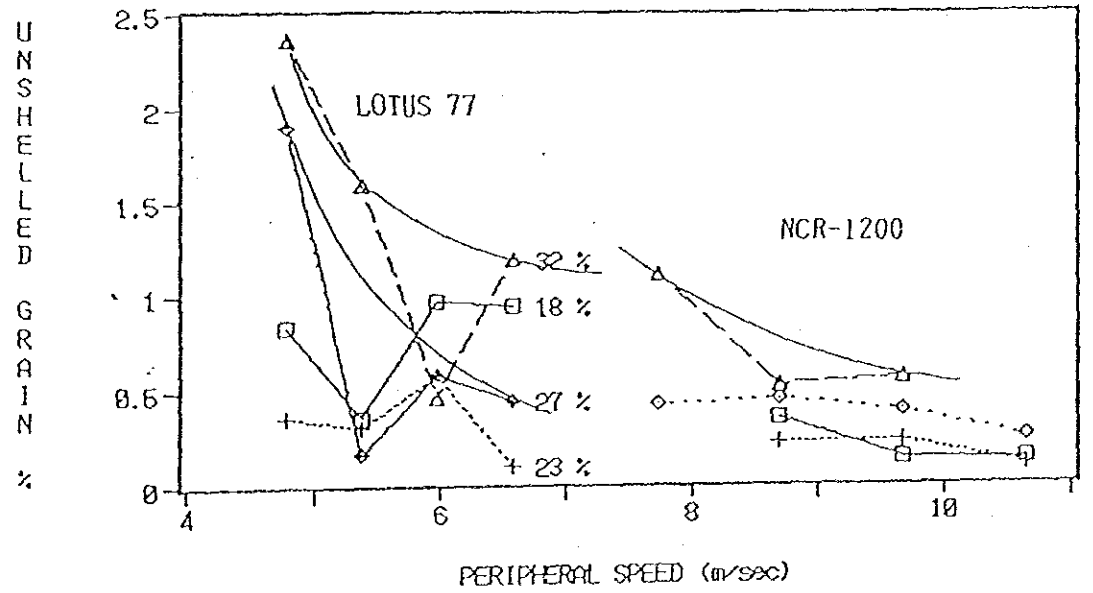


Fig.2 Relation Between Peripheral Speed of Shelling Drum and Shelling Efficiency of the "LOTUS 77" and "NCR-1200" Corn Sheller

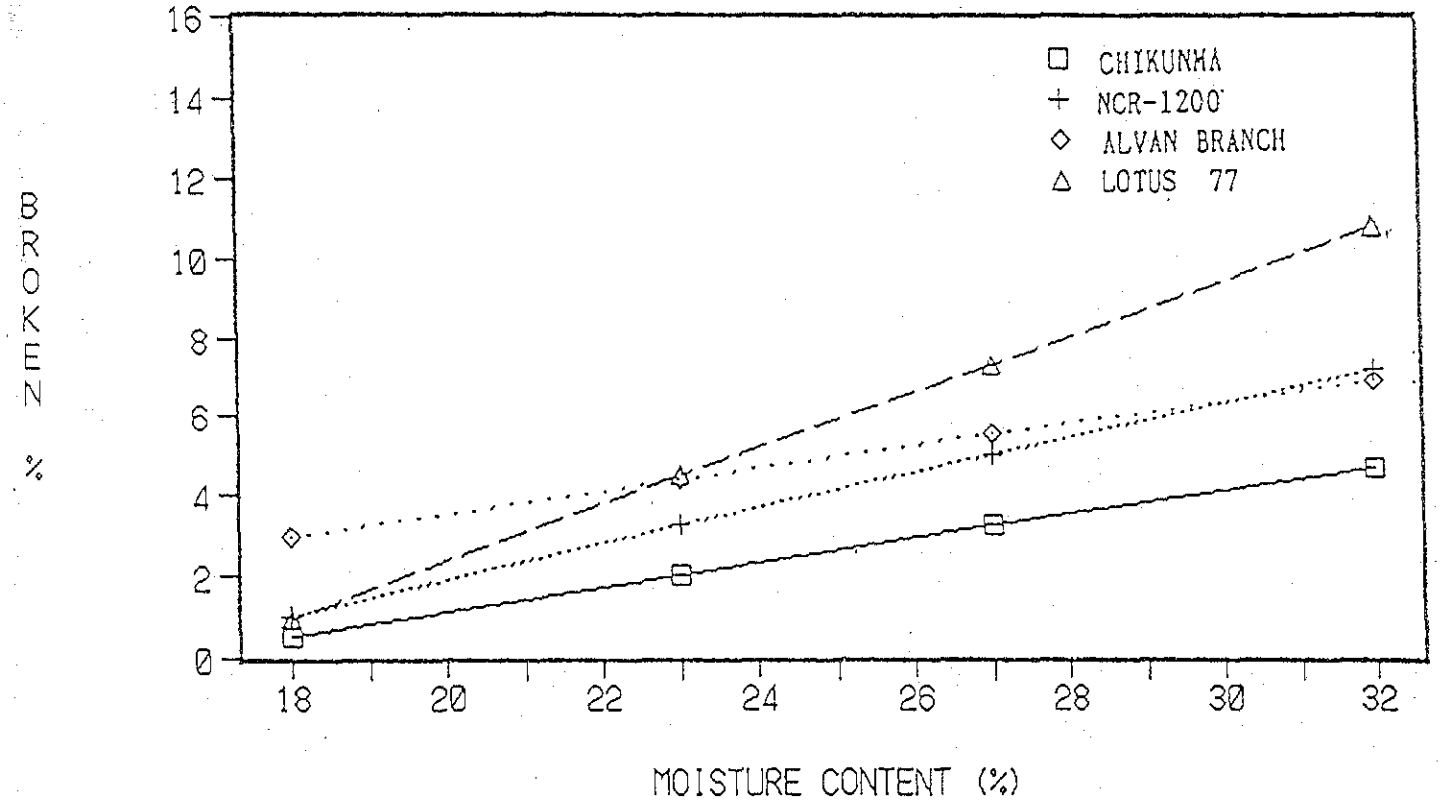


Fig.3 Relation Between Kernel Moisture Content and Broken Kernel Ratio

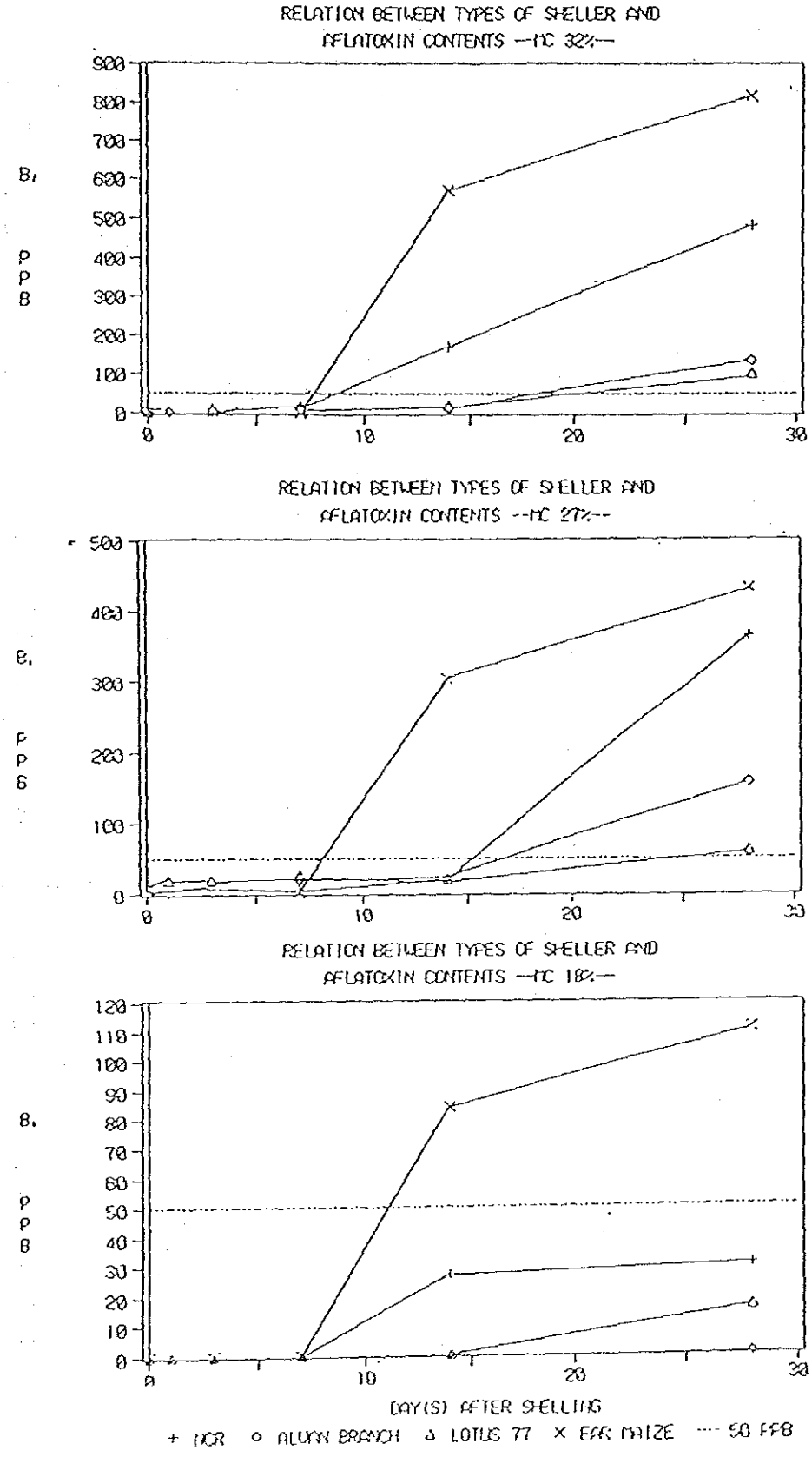


Fig.4 Transition of Aflatoxin Content During Storage Experiment

Table 6 Mechanical Damage on Kernels and Shelling Efficiency

RPM	% MC PROPOSED	% MC REAL[1]	WHOLE KERNELS		BROKEN KERNELS			SHELLING EFFICIENCY
			UNCRACK	CRACK	LARGE[2]	FINE	TOTAL	
CHIKUMA (No.1)			(%)	(%)	(%)	(%)	(%)	(%)
300	18	16.9	95.3	4.1	0.4	0.1	0.5	89.1
	23	23.8	88.0	10.1	1.5	0.4	1.9	90.1
	27	27.0	89.4	7.2	2.4	0.9	3.3	79.0
	32	29.0	86.3	7.1	4.7	1.8	6.5	51.2
400	18	16.8	95.8	3.5	0.4	0.1	0.5	90.9
	23	22.4	89.0	9.0	1.3	0.6	1.9	87.9
	27	26.6	91.7	4.7	2.2	1.3	3.5	80.6
	32	29.3	89.6	6.5	2.7	1.2	3.9	64.7
500	18	16.2	94.7	4.6	0.4	0.1	0.5	89.9
	23	22.8	87.4	10.5	1.4	0.6	2.0	91.1
	27	27.4	91.8	5.3	2.0	0.9	2.9	81.0
	32	31.7	89.1	7.1	2.5	1.3	3.8	61.0
NCR-1200 (No.2)								
400	27	29.4	85.6	9.5	3.5	1.4	4.9	99.6
	32	31.2	74.8	16.7	5.9	2.5	8.4	98.9
450	18	16.6	95.4	3.1	0.9	0.5	1.4	99.7
	23	22.3	88.3	9.3	1.5	0.8	2.3	99.8
	27	26.9	85.8	9.0	3.9	1.3	5.2	99.5
	32	34.4	81.6	10.8	5.5	2.1	7.6	99.5
500	18	15.5	95.7	2.8	1.1	0.5	1.6	99.9
	23	23.9	89.3	7.8	1.7	1.2	2.9	99.8
	27	24.8	89.5	6.4	2.7	1.4	4.1	99.6
	32	33.7	75.6	17.2	5.1	2.2	7.3	99.4
550	18	16.7	96.0	2.4	1.2	0.5	1.7	99.9
	23	24.3	88.0	9.0	1.9	1.1	3.0	99.9
	27	26.1	89.7	6.4	2.2	1.7	3.9	99.8

(CONTINUED)

RPM	% MC PROPOSED	% MC REAL	WHOLE KERNELS		BROKEN KERNELS			SHELLING EFFICIENCY
			UNCRACK	CRACK	LARGE	FINE	TOTAL	
ALVAN BRANCH (No.3)			(%)	(%)	(%)	(%)	(%)	(%)
470	18	15.4	94.8	2.9	1.2	1.1	2.3	99.1
	23	22.7	82.8	12.6	3.0	1.6	4.6	97.5
	32	31.8	77.1	15.8	5.1	2.1	7.2	95.0
520	18	17.5	92.8	3.9	1.9	1.4	3.3	99.2
	23	24.8	81.5	13.8	3.5	1.2	4.7	98.1
	27	26.8	76.6	18.8	3.1	1.9	5.0	95.5
570	18	16.5	92.9	4.0	1.7	1.4	3.1	99.5
	23	24.0	81.2	13.6	3.8	1.4	5.2	98.7
LOTUS 77 (No.4)								
400	18	16.3	95.0	3.5	1.0	0.5	1.5	99.2
	23	22.6	75.9	20.2	2.9	1.0	3.9	99.6
	27	27.7	75.8	16.3	6.2	1.7	7.9	98.1
	32	31.7	73.6	14.9	8.1	3.4	11.5	97.6
450	18	15.9	94.7	3.6	1.3	0.5	1.8	99.6
	23	23.0	79.9	15.5	3.7	1.0	4.7	99.7
	27	29.5	72.9	21.3	4.7	1.2	5.9	99.8
	32	33.0	73.5	16.6	7.0	2.8	9.8	98.4
500	18	16.8	96.6	2.2	0.7	0.4	1.1	99.0
	23	22.4	82.2	13.5	3.5	0.8	4.3	99.4
	27	26.3	81.2	12.0	5.1	1.8	6.9	99.4
	32	33.3	61.4	24.1	11.5	3.0	14.5	99.5
550	18	16.3	96.0	2.7	0.9	0.4	1.3	99.1
	23	21.8	83.2	13.5	2.2	1.1	3.3	99.9
	27	27.0	82.3	11.7	4.6	1.4	6.0	99.6
	32	32.8	68.4	21.5	7.0	3.1	10.1	98.8

1) Kernel moisture contents were measured by constant temperature oven method ; 103 ℃, 72 hrs.

2) Large broken; particle size is more than 2/3 of original size.

Ammonia Treatment of Maize to Control *Aspergillus* spp. and so Prevent Aflatoxin Contamination

Code No. II-3-(2)-C-a)-(i) and II-3-(2)-C-a)-(ii) (1988 ~1989)

Background and Objectives

It is already known that ammonia and several kinds of chemicals are able to suppress multiplication of certain kinds of fungus and to destroy aflatoxin to a certain extent. In Japan, ammonia treatment techniques for high moisture hay have already been established and are in an extension stage. In this experiment it is intended to estimate the effectiveness of ammonia treatment for preservation of maize without reducing the characteristics of Thai yellow maize. Also, it is intended to develop practical ways of applying ammonia treatment to ear and/or shelled maize to prevent aflatoxin contamination.

Methods and Procedures

On this subject, two experiments were conducted. Ammonia solution, anhydrous ammonia and urea were applied as the ammonia source.

① A small scale experiment with high density polyethylene bottles was conducted to estimate the effective concentration level for preserving maize by ammonia treatment. The variable factors were; two kinds of ammonia source (ammonia solution and urea), three levels of kernel moisture content (20 ,25 and 30% wb.), five levels of ammonia concentration (0.25, 0.50, 0.75, 1.00 and 2.00% w/w), three intervals after harvest (0, 7 and 14 days) and three conditions of maize prior to ammonia treatment (hand shelled, mechanically shelled and unshelled). The sample weight for each treatment was approximately 50g of kernels, and each treatment was conducted in duplicate. An enzyme water solution made from soybean was applied as an activator to the urea to break it down and so produce ammonia. Duration of the ammonia treatment was two weeks, after which then all the bottles were opened. One replicate of each treatment was inspected for fungus infection visually, and the others were kept another two weeks and inspected in the same manner. Visual inspection was done by the project's Microbe Section.

② The ammonia treatment for ear and grain maize packed in gunny sacks was conducted individually to estimate the effect of ammonia regarding the preservation of maize. The variable factors were; two kinds of ammonia source (anhydrous ammonia and urea), three levels of the initial moisture content of the kernels (20, 25 and 30%), two conditions of the maize (mechanically shelled and ear maize) and two types of containers for ammonia treatment (plastic stack silo and plastic bag silo). Ammonia concentration was 0.5 % of the gross weight of the samples. 80 kg of shelled maize and 60 kg of ear maize were taken as the unit for each treatment, and each

treatment was replicated three times. Enzyme water solution made from soybean was applied as an activator to break down the urea and so produce ammonia. Duration of the ammonia treatment was two weeks, and the storage experiments were conducted for another four weeks in a middleman's storage facility. Samples for aflatoxin contamination analysis were extracted 0, 1, 3, 5, 7, 14, 21, 28 days after two weeks of ammonia treatment. Visual inspection for *A.flavus* and quantitative analysis were dane by the project's Microbe Section.

Summary of the Results

① Small scale experiment:

a. There was no *A.flavus* infection on the ammonia treated kernels.

b. Other than *A.flavus*, ammonia was able to suppress activities of molds. Ammonia solution was more effective than urea, as applied at the same concentration.

c. Wide spread discolouration of grain was observed after all treatments, and the tone of the heated orange colour produced was darker in higher ammonia concentration treatment.

② On farm size application (Table 7):

a. It was recognized that the ammonia treatment for higher moisture content shelled maize was more effective in suppressing *A.flavus* activities.

b. Anhydrous ammonia was more effective in comparison with urea, but the effect of the two different treatment silos was not clear.

c. Ammonia treatment of ear maize more effectively suppressed *A.flavus* activities than the treatment of shelled maize.

d. Regarding mold infection other than *A.flavus;* during inspection on the day of completion of treatment, yeast and fungus were observed and their presence increased during storage especially after urea treatment.

e. Wide spread discolouration of grain was observed after all kinds of ammonia treatments.

View to the Next Year

From this year's results, *A.flavus* infection was effectively prevented by ammonia treatment, but other mold was not controlled. Next year, further study is to be continuously conducted. The concentration of ammonia applied is to be changed and changes to the application methods are also to be considered in the next year. Applying other chemicals is also to be considered.

Table 7 *A.flavus* Infection Changes During Storage Estimated by Visual Inspection.[1]

a. Shelled Grain

Day(s) from Treatment Finish Date	Control						Anhydrous Ammonia						Urea					
	Sun Dry			No Dry			Stack Silo			Bag Silo			Stack Silo			Bag Silo		
	Initial Grain Moisture Content (%) [2]																	
	20	25	30	20	25	30	20	25	30	20	25	30	20	25	30	20	25	30
0	±	±	±	±	±	±	0	0	0	0	0	0	0	0	0	0	0	0
1	1	1	1	±	±	1	0	0	0	0	0	0	0	0	0	0	0	0
3	1	1	1	1	1	2	0	0	0	0	0	0	0	0	0	0	0	0
5	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	1	0	0
7	±	1	1	±	1	1	–	–	–	–	–	–	–	–	–	–	–	–
14	±	1	±	±	1	1	0	0	0	0	0	1	1	1	1	1	0	0
21	±	±	±	3	5	3	1	0	0	5	0	0	5	1	0	1	1	0
28	1	1	1	1	±	1	0	0	0	0	0	0	5	2	1	1	0	0

b. Ear

Day(s) from Treatment Finish Date	Control						Anhydrous Ammonia						Urea					
	Sun Dry			No Dry			Stack Silo			Bag Silo			Stack Silo			Bag Silo		
	Initial Grain Moisture Content (%)																	
	20	25	30	20	25	30	20	25	30	20	25	30	20	25	30	20	25	30
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	±	±	0	±	±	±	0	0	0	0	0	0	0	0	0	0	0	0
3	±	0	±	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	±	0	0	±	±	±	–	–	–	–	–	–	–	–	–	–	–	–
14	±	0	0	±	±	±	0	0	0	0	0	0	0	0	0	1	1	0
21	±	±	±	±	±	0	0	0	0	0	0	0	0	0	0	2	5	0
28	±	0	0	±	1	0	0	0	0	0	0	0	0	0	0	1	3	0

1: Score for fungus infection rate is not same for the control and the ammonia treatment. For the control, each score indicates as follows: 0;no *A.flavus*, ±;less than 5% was infested by *A.flavus*, 1 to 5;each hierarcy consist of 20% interval from 20% infection rate to 100% infection rate.
For the ammonia treatment, each score indicates as follows: 0;no *A.flavus*, 1;less than 10% was infcted by *A.flavus*, 2;more than 10% and less than 50% was infected, 3;more than 50% and less than 80% was infected, 4;almost all kernels were infected, 5;vigorous growth of *A.flavus* could be observed on almost all kernels.

2: Initial moisture contents listed in the table are the proposed moisture contents for the variable factors of this experiment. Actual moisture contents at treatment time were 25.0%, 27.3% and 29.4% for 20%, 25% and 30%.

Improvement of Moisture Meter
Code No. II-2-(2) (1988 ~1989)

Background and Objectives

Moisture content is one of the most important factors in quality control of grain especially in controlling fungus infection. It is intended, in this study, to improve and to develop a simple and accurate moisture meter with a low cost. Calibration of existing moisture meters and standardization of the oven method are also to be done.

Methods and Procedures

The Dole-400, CTR-800 and GRAINER moisture meters were tested to see if they could be calibrated to the standard constant temperature oven method developed by USDA.(103℃, 72 hrs.)
Standardization of the constant temperature oven method was attempted in order to conform with the official methods specified by USDA, ISTA.etc.

Summary of the Results

① The calibration equations of the "Dole 400" and "CTR-800 (single kernel moisture meter)" were made.(Fig.5 and 6) However, the "Grainer" meter did not show linearity to the standard oven method, so it was rejected as an object of our study.
② A moisture meter for ear maize was developed. However a moisture meter for shelled maize was not developed, because the "Dole-400" moisture meter is low cost and accurate enough, if it is calibrated.
③ Study on improving the standard oven method is not finished.

View to the Next Year

Calibration of the established moisture meter is to be continued. A calibration test of the newly developed moisture meter is to be conducted. Also the study on improvement of the oven method and standardization of it is to be continued.

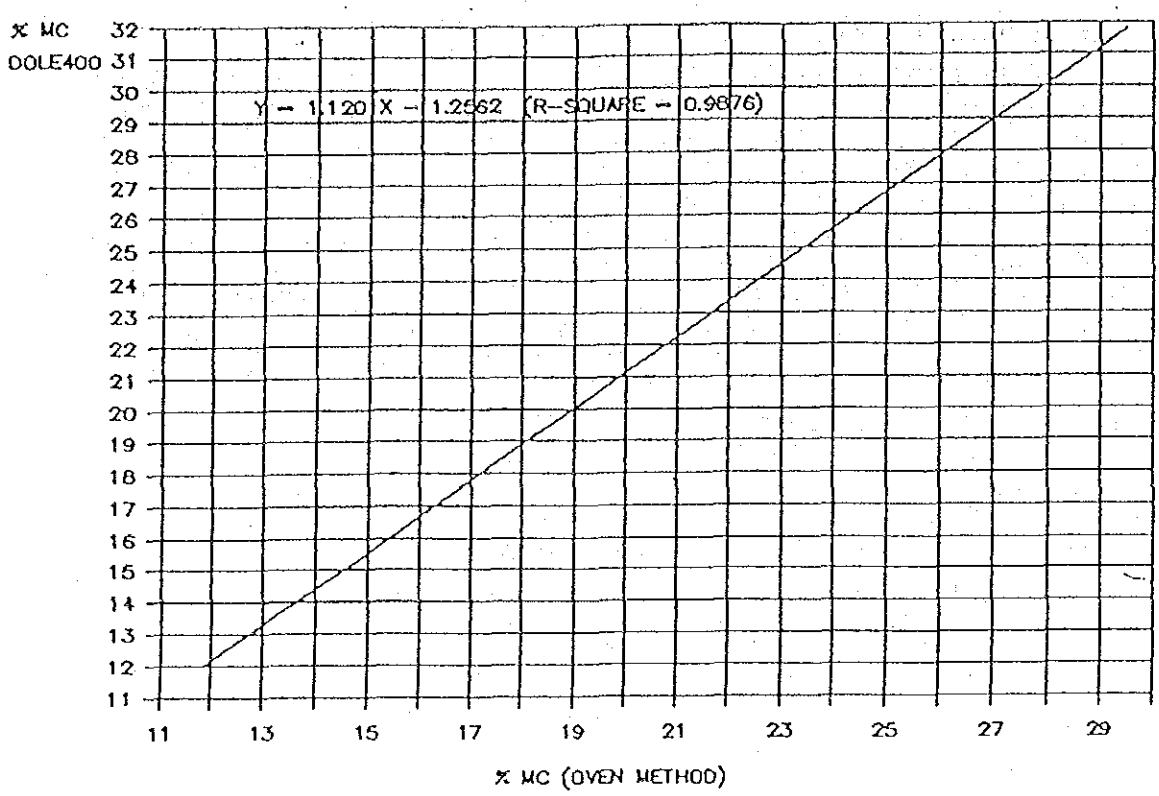


Fig.5 Calibration Equation of the DOLE-400 Moisture Meter to the 103℃, 72 hrs. Constant Temperature Oven Method

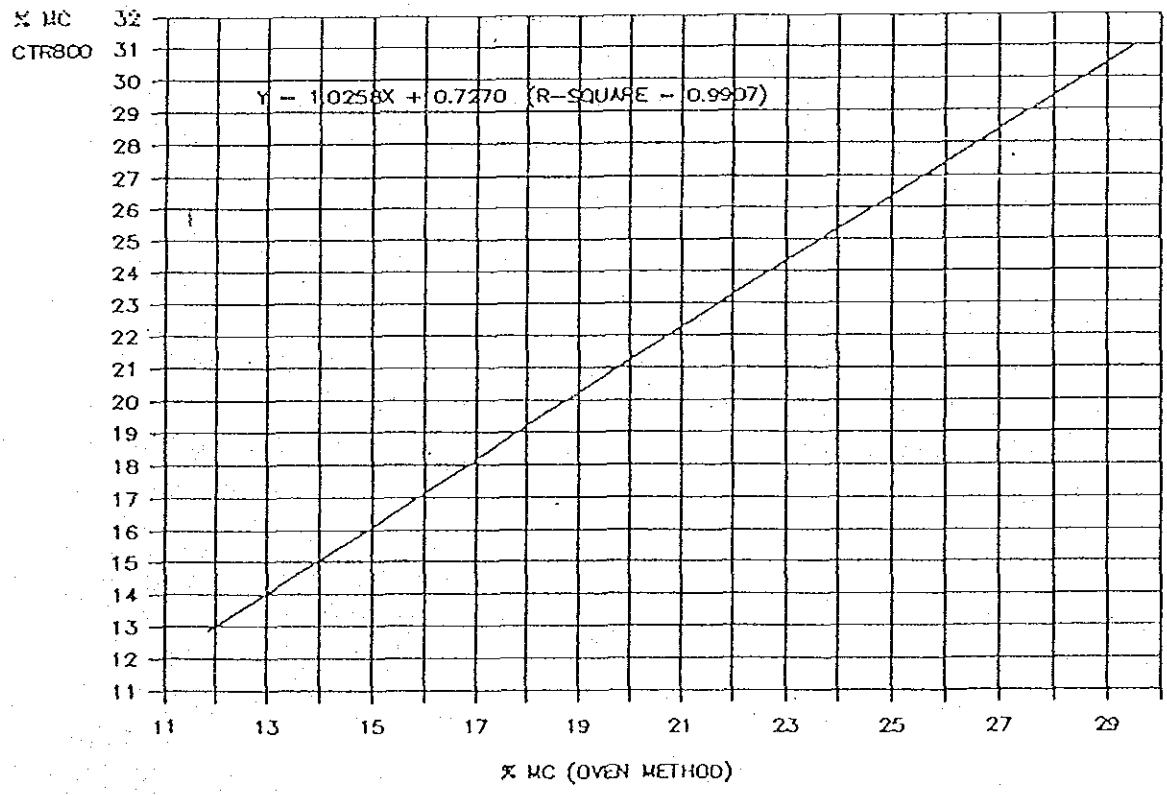


Fig.6 Calibration Equation of the CTR-800 Moisture Meter to the 103 ℃, 72 hrs. Constant Temperature Oven Method

III. Microbe Research

Studies on the Effect of Ammonia Treatment for Prevention of Fungus Invasion on Ear and Grain Maize

Code No. III-1-(2) (1988 ~ 1989)
Related Code No. II-3-(2)-c-a)-i) & -ii)

Microbiological studies on the effect of ammonia treatment for maize to extend its storage period have been carried out by the Post-Harvest and Microbe Sections.

Materials and Methods

Maize samples were collected and treated by the Post-Harvest Section and microbiological studies and aflatoxin analysis were carried out by the Microbe Section.

The experiments were divided into two parts. The first part consists of the basic studies on the influence of different ammonia concentrations applied to maize of different moisture contents, different storage period of maize after harvest and different forms of maize using small plastic containers (Experiment 1). The second part is the practical storage experiment of ammonia treatment for maize using plastic stack silos and plastic bags at an ammonia concentration of 0.5% (Experiment 2).

The Microbe Section has established a new method for evaluation of fungus infection ratio (A.flavus) and discoloration. Samples collected and prepared by the Post-Harvest Section were sent to the Microbe Section, and kept in a cold room at 5 C for a short time. Then, fungi and color were observed.

In the beginning of experiment-1, the basic study of ammonia treatment for maize, the infection ratio by A.flavus was estimated by means of the cultivation inspection method. 200 kernels from each sample were inoculated on 40 petri dishes containing PDA (Potato Dextrose Agar) culture. That is, 5 kernels, whose surface was sterilized with Sodium hypochlorite solution, were properly spaced on a petri dish. Then, they were incubated at 26 C for 4~5 days.

This method, however, takes long time to get final results and requires a huge number of petri dishes even for a small number of samples. Therefore, in the middle of the experiment, the estimation method of infection by fungus was switched to a visual inspection method, as this is a simple and a rapid way to deal with a large number of samples in a limited time. With this method, the infection ratio or discoloration of kernels or ear corn was evaluated by the sensorial method according to a standard procedure and converted to a score as mentioned in table 1~2.

Table 1 Standard for Estimation of Maize Kernels Infected by Fungus.

-	(0)	No growth of any fungi can be observed in any kernels.
+	(10)	Growth of fungi can be observed in less than 10% of all kernels.
++	(50)	Growth of fungi can be observed in less than 50% of all kernels.
+++	(80)	Growth of fungi can be observed in less than 80% of all kernels.
++++	(100)	Growth of fungi can be observed in almost all kernels.
+++++	(100)	Vigorous growth of fungi can be observed in all kernels.

Table 2 Standard for Estimation of Discoloration of Maize Kernels Caused by Ammonia.

-	(0)	No discoloration
+	(25)	Slightly discolored
++	(50)	Evidently discolored
+++	(75)	Discolored to pale brown
++++	(100)	Pale brown to blackish brown
+++++	(100)	Blackish brown to dark blackish brown

In experiment 2, the large scale experiment, the A.flavus and other fungi infection ratios were also estimated by the sensorial method. At first, the A.flavus infection ratio by of the control samples (no ammonia treatment) was estimated by the cultivation and inspection method. However, for the same reasons mentioned previously, estimation was switched to the visual inspection method. For the control samples, the number of kernels infected by A.flavus and other fungi in a total of 200 kernels was estimated. For ear corn samples, the number of spots infected by A.flavus and other fungi in 3 ears was estimated. However, in the case of the samples in the large scale ammonia experiment using plastic stack silos and bags, the total fungi infection ratio and discoloration were estimated by a sensorial method and converted to a score as mentioned in the basic study.
Aflatoxin analysis of maize samples was carried out by means of both BGYF (Bright Greenish Yellow Fluorescence) and TLC (Thin Layer Chromatograph) methods. The samples prior to analysis were dried in the sun or by means of a ventilation type electric dryer until their moisture content was reduced to 15%.
First, all samples were ground by means of an ultra centrifugal mill using 1 mm aperture sieve. Then, they were roughly screened by the BGYF method into two groups; zero and above 20 ppb aflatoxin content. Second, the over 20 ppb group was further analyzed by means of the TLC method.

Results and Discussion
Details of the results may be referred to in the Annex to this paper, Code No. II-3-(2)-c-a)-i) & ii)

Studies on the Aflatoxin Content in Maize Shelled by Different Types of Corn Sheller under Various Operating Conditions and Moisture Contents of Maize
Code No. III-1-(2) (1988 - 1989)
Related Code No. II-1-(2)-B-a) & -b)

This subject was conducted as a joint research project by the Microbe and Post-Harvest Sections. The Microbe Section analyzed the aflatoxin content of the maize samples prepared by the Post-Harvest Section.

Materials and Methods
Mechanical damage to grain when it is shelled is one of the biggest causes of infection by A.flavus and also the occurrence of mechanical damage to grain is closely related to the moisture content of raw maize.
The moisture content of maize was adjusted to 4 levels in the field and it was shelled by 4 types of corn sheller under various operating conditions. Shelled grain was packed in gunny bags and stored for 4 weeks. Periodically, samples were extracted and sent to the Microbe Section for aflatoxin analysis.
The analytical methods used to detect aflatoxin were the BGYF and TLC methods. First, all samples were ground by means of an ultra centrifugal mill using a 1 mm aperture sieve. Then, they were roughly screened by the BGYF method into two groups; zero and above 20 ppb aflatoxin content. Second, the over 20 ppb group was further analyzed by means of the TLC method.

Results and discussion
Details of the results may be referred to in the Annex to this paper, Code No. II-3-(2)-(c)-(a)-(i & ii)

Studies on the Aflatoxin Content of Maize Cultivated under Different Conditions.
Code No. III-1-(1)-A & -B (1988 - 1989)
Related Code No. I-1-(1)-A~J

This subject was studied as a joint research project by the Microbe and Agronomy Sections. The Microbe Section analyzed the aflatoxin content of the maize samples cultivated and prepared by the Agronomy Section. Also, the Microbe Section estimated the kinds and levels of soil fungi in the field where maize was cultivated.
The Agronomy Section is studying the relationship between cultural practices and aflatoxin contamination of maize.
The studies were carried out to clarify the relationship between aflatoxin contamination and maize variety; its physiological, ecological and morphological features; environmental factors including climate; soil and outbreak of insect pest or disease; and finally cultivation practices.
Analytical methods used to detect aflatoxin contamination were the BGYF and TLC methods.

First, all samples were ground by means of an ultra centrifugal mill using 1 mm aperture sieve. Then, they were roughly screened by the BGYF method into two groups; zero and above 20 ppb aflatoxin content. Second, the over 20 ppb group was further analyzed by means of the TLC method.

Results and Discussion

Details of the results may be referred to in the Annex to this paper, Code No. I-1-(1)-A~J.