



THAI AGRICULTURAL STANDARD

TAS 4402- 2010

**GOOD AGRICULTURAL PRACTICES FOR
MAIZE**

**National Bureau of Agricultural Commodity and Food Standards
Ministry of Agriculture and Cooperatives**

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National Bureau of Agricultural Commodity and Food Standards

Ministry of Agriculture and Cooperatives

50 Phaholyothin Road, Ladyao, Chatuchak, Bangkok 10900

Telephone (662) 561 2277 Fax (662) 561 3357

www.acfs.go.th

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**Technical Committee on the Elaboration of Thai Agricultural Standards on
Good Agricultural Practices for Maize**

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National Bureau of Agricultural Commodity and Food Standards | Member and Secretary |

Maize is an agricultural commodity of economic importance as a raw material for food and feed industries. It is an agricultural commodity that provides an option for import under the agreement of ASEAN Free Trade Area (AFTA). Therefore, for the benefit of Thai farmers, the Agricultural Standards Committee deems it necessary to establish the standard on Good Agricultural Practices for Maize so as to produce high quality maize.

The standard is based on the following documents:

Department of Agriculture, Ministry of Agriculture and Cooperatives. B.E. 2547 (2004). Good Agricultural Practices for Maize.

Joint FAO/WHO Food Standards Programme, FAO, Rome. 1985. Codex Standard for Maize. CODEX STAN 153.



NOTIFICATION OF THE MINISTRY OF AGRICULTURE AND COOPERATIVES

SUBJECT: THAI AGRICULTURAL STANDARD:

GOOD AGRICULTURAL PRACTICES FOR MAIZE

UNDER THE AGRICULTURAL STANDARDS ACT B.E. 2551 (2008)

Whereas the Agricultural Standards Committee deems it necessary to establish an agricultural standard on Maize in accordance with the Agricultural Standards Act B.E. 2551 (2008) to promote such agricultural commodity to meet its quality, standard and safety.

By virtue of Section 5, Section 15 and Section 16 of the Agricultural Standards Act B.E. 2551 (2008), the Minister of Agriculture and Cooperatives hereby issues this notification on establishment of Thai Agricultural Standard: Good Agricultural Practices for Maize (TAS 4402-2010), as a voluntary standard, details of which are attached herewith.

Notified on 4 October B.E. 2553 (2010)
(Mr. Theera Wongsamut)
Minister of Agriculture and Cooperatives

THAI AGRICULTURAL STANDARD
GOOD AGRICULTURAL PRACTICES FOR MAIZE

1 SCOPE

1.1 This Thai Agricultural Standard (TAS) on Good Agricultural Practices (GAP) for Maize applies to all production steps from cultivating to post-harvest handling at farm level.

1.2 This standard shall be jointly implemented with TAS 4002, Thai Agricultural Standard for Maize.

2 DEFINITIONS

For the purpose of this standard:

2.1 Maize (corn) means a grain of *Zea mays* L., in the *Gramineae* family, having hard kernels with high starch content. It is used for food, feed or raw materials for food and feed.

2.2 Unhusked maize (corn) ear means a mature whole ear (full maturity without the removal of its leafy outer covering).

2.3 Husked maize (corn) ear means an ear as referred to in Section 2.2 with the removal of its leafy outer covering but un-shelled.

2.4 Maize (corn) kernel means a whole shelled grain excluding seed for planting.

2.5 Damaged ear means an ear that contains the kernels which are germinated, broken, obviously damaged by fungi, insects and other pests, or the ear with abnormal colour and odour.

2.6 Visual inspection means an inspection of any external physical appearances of an item, for example produce, product, or apparent environment conditions. This is basically examined by eyes. Any other sensory evaluation may be applied depending on quality factors in question, and additional tools may be applied such as magnifying lens as necessary. Subsequently, physical appearances and environmental conditions shall be assessed so as to see if the criteria are fully met. The processes and working procedures are also necessary to be inspected visually.

2.7 Pesticide means any hazardous substance used in agriculture regulated by the Department of Agriculture in accordance with the Ministry of Industry notification referred to as types and lists of hazardous substance promulgated under the Hazardous Substance Act B.E. 2535 (1992) and its amendments.

2.8 Hazardous substance means any chemical or other substance including chemical product, microorganism and toxin excreted by microorganism that may be harmful to human, animal, plant, properties or environment.

2.9 Pest means any living organism such as plant, animal or microorganism that causes damage to plant.

2.10 Traceability means the ability to trace and track the produce from a specified step or various steps of production at farm level, processing, and distribution.

3. REQUIREMENTS AND INSPECTION METHODS

Requirements and inspection methods shall be as Table 1.

Table 1 Requirements and inspection methods

(Section 3)

Items	Requirements	Inspection Methods
1. Water source	1. Water shall be from a source that does not contain residues or contamination of hazardous substances and pesticides to maize kernels at the level that may be harmful to the consumers.	1. Visual inspection of the environment. If there is any risk, the water quality shall be analysed.
2. Planting area	2. Planting area shall not contain any residue or contamination of hazardous substances and pesticides to maize kernels at the level that may be harmful to the consumers.	2. Visual inspection of the environment. If there is any risk, the soil quality or the produce shall be analysed.
3. The use of pesticides	3.1 Operators shall acquire proper knowledge and skill on the use of pesticides.	3.1 Interview the operator on the knowledge and operation skill or check the training records.
	3.2 In case where the use of pesticides is necessary, follow the recommendations of the Department of Agriculture, Ministry of Agriculture and Cooperatives, or the recommendations on the labels registered with the Department of Agriculture, Ministry of Agriculture and Cooperatives.	3.2.1 Inspect the pesticide storage area. 3.2.2 Check records of pest survey and pesticide application. 3.2.3 In case where there is evidence or situation to believe that the use of pesticides is not adhered to the recommendations, the produce shall be randomly sampled for residue analysis.
4. Pre-harvest Quality Management	4.1 No burning of maize stubbles prior to soil preparation.	4.1 Visual inspection of planting area and interview the worker.

Items	Requirements	Inspection Methods
	4.2 After planting, proper use of pest control according to the official recommendations shall be carried out.	4.2 Check records of pest survey and pesticide application, and/or visual inspection and interview.
5. Harvest and Post-harvest Handlings	<p>5.1 Harvest the produce at the maturity stage based on the following considerations:</p> <ul style="list-style-type: none"> - number of days after planting for at least 110 days (in the rainy season) and 120 days (in the dry season), or according to the varieties, or - 80% to 90% of maize leaves in the field are dry and maize kernels are at full maturity, or - take the seed to observe a black layer at the base of maize kernel, or - the moisture content of maize kernels does not exceed 30%. 	5.1 Check records of harvesting and visual inspection.
	<p>5.2 Harvesting methods</p> <ul style="list-style-type: none"> - By labour, either unhusked maize ears or husked maize ears shall be harvested according to the requirements referred to in Section 5.1. - By mechanical, i.e., a corn snapper, the maize ears shall be harvested according to the requirements referred to in Section 5.1. - By mechanical, i.e., a corn picker-sheller or a combine harvester, when moisture content of maize kernels does not exceed 22%. 	5.2 Interview the operator/worker on the procedures or harvesting practices for unhusked maize ears or husked maize ears, and/or randomly check the produce, and/or check records of harvesting.
	5.3 Damaged maize ears shall be culled off.	5.3 Interview the operator/worker on the procedures or harvesting practices for unhusked maize ears or husked maize ears, and/or randomly check the produce.
	5.4 Maize drying shall be done immediately after harvest as follows:	5.4 Inspect procedures, drying practices, operating area, and records of operation, and/or interview.

Items	Requirements	Inspection Methods
	- maize kernels shall be distributed immediately within 24 hours. If the distribution can not be done on time, the moisture content shall be reduced to not exceed 18% within 2 days and stored not more than 3 days.	
6.Storage and Transportation 6.1 Storage	6.1.1 Storage area shall be well-ventilated, dry, free from insects and disease carrying animals, and not be located near the pesticide storage area.	6.1.1 Visual inspection of storage area and storage practices, and interview.
	6.1.2 The recommended moisture content and storage period are specified in Table 1. The quality of maize kernels shall be in compliance with the requirements of Thai Agricultural Standard for Maize (TAS 4002).	6.1.2 Check moisture content of maize kernels, the storage temperature, and/or interview.
	6.1.3 Maize ears shall not be piled up to a height of more than 1 m.	6.1.3 Visual inspection of storage area.
6.2 Transportation	6.2.1 Vehicles for transportation shall be clean and free from hazardous substances.	6.2.1 Visual inspection of vehicles and/or interview.
	6.2.2 Preventive measures shall be in place to avoid the increase of moisture content of maize during transportation.	6.2.2 Visual inspection of vehicles and preventive measures, and/or interview.
7. Personal health	7. Provide appropriate health care and preventive measures to workers.	7. Visual inspection, and/or interview, and check the preventive measures.
8. Record Keeping	8.1 Availability of records for inspection and traceability as follows: - sources of production inputs - the use of pesticides - cultivating and harvesting - buyers or distributors of each crop of production	8.1 Check records.
	8.2 Records shall be kept for at least 2 years.	8.2 Check records.

Table 1 Moisture content of maize kernels and safe storage period
(Section 6.1.2)

Type of Maize	Average Moisture Content (%)	Storage Period
Unhusked maize ears	not exceed 23	not over 30 days
	not exceed 20	not over 45 days
	not exceed 18	not over 60 days
	not exceed 15	not over 90 days
Husked maize ears	not exceed 23	not over 15 days
	not exceed 20	not over 30 days
	not exceed 18	not over 45 days
	not exceed 15	not over 60 days
Maize kernels	not exceed 18	not over 3 days
	not exceed 15	not over 5 days
	not exceed 13	not over 30 days

4. GUIDANCE FOR GOOD AGRICULTURAL PRACTICES FOR MAIZE

Recommendations on Good Agricultural Practices for maize are aimed to be used as a guideline for producing maize of high quality, safe and suitable for food, feed, and raw materials for food and feed. The details are explained in Appendix A.

APPENDIX A

GUIDANCE ON GOOD AGRICULTURAL PRACTICES FOR MAIZE

A.1 WATER SOURCE

A.1.1 Water used in the production process shall be from a source that does not contain residues or contamination of hazardous substances and pesticides to maize kernels. The water quality shall be suitable for agricultural purpose. In case where there is any suspect of contamination from hazardous substances in the water, clear evidence shall be provided to clarify that the water can be used for its purpose.

A.1.2 At least one sample should be collected and sent to an accredited laboratory for contamination analysis either at an early stage of setting up the agricultural system and during a period that the environmental condition is risky for production. The laboratory report shall be kept as evidence.

A.2 PLANTING AREA

A.2.1 The planting area shall not contain any residue or contamination of hazardous substances and pesticides. In case the planting area is located near or in the vicinity of industry, or in any risky area, the soil quality should be analysed at least once at an early stage of setting up the agricultural system. Soil samples should be collected and sent to an accredited laboratory. The laboratory report shall be kept as evidence.

A.2.2 Plot identification codes and records should be set up to indicate name of the owner, name of the responsible person (optional), contact address, location, species and varieties, history of land use at least in the past 2 years, and other relevant details.

A.2.3 Land use for planting should be subject to the provision of relevant laws and regulations.

A.2.4 In case of new planting area, the land should not cause any negative impact to the environment. If there is any risk of impact, preventive measures and corrective actions should be conducted to minimize further damage.

A.3 THE USE OF PESTICIDES

A.3.1 The use of pesticides shall be complied with the recommendations of the Department of Agriculture, or the recommendations on the labels registered with the Department of Agriculture, Ministry of Agriculture and Cooperatives. Besides, the pesticide application corresponding to the detected pest shall be carried out.

A.3.2 Use only the pesticides that are legally registered with registration numbers and prescribed labels for maize. Do not use pesticides that are banned from production, import, export, or in possession according to the Hazardous Substance Act B.E. 2535 (1992) and its amendments and those indicated in prohibited lists of trading countries or trading requirements. In any case, the pesticides prohibited in Thailand shall not be used. The use of pesticides shall be withheld prior to harvesting stage as indicated on the labels or in compliance with the official recommendations.

A.3.3 Read recommendations on the labels in order to understand properties of the pesticides and their application methods before use.

A.3.4 A pesticide operator/supervisor shall acquire the proper knowledge and the skill of particular pests, selection and application rate of pesticides, selection of chemical sprayers and their nozzle equipment including spraying methods. The sprayers shall be checked and maintained in a functional condition at all time for an effective use. The pesticide operator should have the personal protective equipment (PPE) such as mask or nose covering cloth, gloves, cap and boots in order to prevent danger from such pesticide. The use of pesticide mixture for more than two types shall be avoided unless it is complied with technical recommendations.

A.3.5 Pesticides shall be prepared in accordance with the recommendations. The solution shall be mixed well to make it homogeneous before spraying. It is recommended that spraying of pesticides should be done in the morning or in the evening when the wind is calm and avoid strong sunlight or strong wind. The pesticide operator shall be at windward position during spraying at all times and should prevent the chemical mist to the nearby plot and the surrounding area.

A.3.6 A sufficient amount of pesticide shall be prepared and completely used at once. No leftover of pesticide should be in the spraying tank.

A.3.7 When the pesticide container is empty, it shall be rinsed 3 times with water. The rinsed water shall be discarded into the spraying tank so that it can be used for further spraying in the plot where an application of specific pesticide is approved in accordance with the recommendation prescribed on its label or in designated area. In addition, it shall be ensured that there is no risk of contamination from water source to the produce. The empty pesticide container shall be eliminated to prevent its reuse. It is then dumped into an area particularly provided for a container of that kind, or buried in the ground deep enough to prevent it from animal digging, and at least 50 m away from water sources and residential area. Burning of pesticide containers is strictly prohibited.

A.3.8 Immediately after pesticide application, the operator shall take a bath, hair shampoo and change clothes. All clothes worn during spraying of pesticides shall be well laundered and separated from routine laundry.

A.3.9 When there is the pesticide remaining in the container, its container lid shall be tightly closed and stored in the pesticide storage area.

A.3.10 All pesticides shall be stored in a secure location with good ventilation, away from children and pets, and rain and sunlight proof.

A.3.11 All pesticides and other chemicals e.g. fuel shall be stored separately in the proper storage area in order to prevent their contamination on the produce and environment. Once the container of pesticide has been opened, its content shall not be transferred out of the original container.

A.3.12 Pesticides shall be kept with clear indication and stored separately from fertilizers, plant growth regulators, various plant supplementary nutrients and PPE.

A.3.13 Provide First Aid and tools for accidental prevention such as eyewash, clean water, sand or fire extinguisher in the pesticide storage area.

A.3.14 Plant protection measures shall be appropriate for pest control and based on pest monitoring and survey.

A.3.15 An appropriate integrated pest management shall be applied to reduce the use of pesticides. Integrated Pest Management (IPM) means a pest control management system that combines the details of pest population changes and their interaction with the environment as well as integration of appropriate techniques and methods for the reduction of pest population to below the economic threshold level.

A.3.16 Avoid the repeated use of the same pesticides to delay the development of pesticide resistance in pests.

A.3.17 Workers and pesticide operators should acquire general knowledge and skill in preventing themselves from the hazards of chemical application, as well as First Aid provision.

A.3.18 Safety instructions for an accident or emergency shall be visibly seen in the chemical storage area.

A.4 PRE-HARVEST QUALITY MANAGEMENT

A.4.1 Seeds shall be in good quality, selected from reliable sources and shall conform to the characteristics of the variety. The germination shall not be less than 95%. The size of seeds shall be homogeneous with impurities not more than 0.5%. The seeds shall be contained in closed and good packages, either in bag or in box. There shall be a clear label indicating date of production, name and address of manufacturer. The seeds shall be treated with chemicals to prevent them from diseases and insects, and without traces of fungal and insect damages.

A.4.2 Burning of maize stubbles prior to soil preparation is prohibited since it would lead to the loss of soil nutrients. The stubble of maize should be left for natural degradation or ploughed under the soil surface during soil preparation as the stubble could help improve soil physical property by softening the soil structure.

A.4.3 Appropriate pest control shall be carried out in accordance with the relevant official recommendations. Plant protection measures shall be effective for pest control and based on pest survey and monitoring. In addition, appropriate Integrated Pest Management shall be carried out in order to minimize the use of pesticides. Farmers should acquire knowledge on the species and life cycles of important pests that cause damages to the produce as well as control methods. In case there is an outbreak of pest, plant debris shall be destroyed (e.g. burning) outside the plot.

A.4.4 Use organic fertilizers from complete decomposition or other processes in order to increase the amount of organic matter in soil and reduce the amount of plant pathogenic microorganisms.

A.4.5 Use only chemical fertilizers registered with the Department of Agriculture, Ministry of Agriculture and Cooperatives. Choose the fertilizer formula based on the soil analysis.

A.4.6 Planting area shall not be located on land with its slope more than 10% because ploughing in such area would result in increasing soil erosion. If necessary, a specific pattern, i.e., contour planting, planting in a zig-zag pattern, contour furrow cultivation and alley cropping with the hedgerows of legume, or terracing is recommended.

A.4.7 Cover crops such as mungbean, sesbania, sunnhemp or jackbean shall be grown to improve soil properties and ploughed when the cover crops have been grown for approximately 50 days or when they start flowering.

A.4.8 Chemical fertilizers should be combined with organic fertilizers because the organic fertilizers could help improve soil physical and biological properties, increase the amount of soil microorganisms, enrich with trace elements more than chemical fertilizers, and enhance the nutrient absorption, which would reduce the nutrient loss of chemical fertilizer application.

A.4.9 To eliminate surplus and waste, infected plant parts shall be burned outside the plot, whereas non-infected plant parts can be used for compost or green manure.

A.4.10 Maize planting during early rainy season should be avoided because there might be a dry spell that could induce a drought stress in maize. Moreover, harvesting during the rainy season is risky to be infected by *Aspergillus flavus*, *Penicillium* spp. and *Fusarium* spp.

A.5 HARVEST AND POST-HARVEST HANDLINGS¹

A.5.1 Appropriate harvesting stage

A.5.1.1 Maize shall be harvested after planting for at least 110 days in the rainy season and 120 days in the dry season, or at harvesting stage suitable for the variety. In addition, the appropriate harvesting stage could be considered when 80% to 90% of maize leaves in the plot are dry, or when maize kernels are at full maturity.

A.5.1.2 The harvesting stage can be observed from the forming of black layer at the base of maize kernel which appears as a tiny black spot indicating that the maize reaches physiological maturity and the accumulation of total dry matters in maize kernels is stopped, which the dry weight becomes maximum in this period.

A.5.1.3 In case of harvesting at the required moisture content, a measurement tool should be used to ensure the accurate moisture content.

A.5.1.4 The appropriate moisture content required for harvesting shall not exceed 30%. However, harvesting when the moisture content is less than 25% would result in maize kernels of quality with less damage from threshing and lower risk from aflatoxin contamination.

¹ Source of data from the collaborative project between the National Bureau of Agricultural Commodity and Food Standards (ACFS) and the Kasetsart University on “A review and analysis of factor, quality and safety of Maize” in order to set up the Thai Agricultural Standard for Maize.

A.5.2 Harvesting method

A.5.2.1 Labour harvesting is the most convenient and popular method. Maize ears can be removed from the plants by hand with or without husking. Husked maize ears shall be harvested by using a wooden stick with sharp end to pierce and carefully cut the ear's tip and try not to damage the kernels so that the husk can be removed from the ear. Afterwards, the husked maize ears are put into the basket or piled up on the ground or floor with supporting material, and not piled up directly on the damp ground. The husked maize ears shall not be thrown in order to prevent damage or cracking of the kernels since the damaged kernels will subsequently enhance fungal damage. On the other hand, the unhusked maize ears shall be harvested and stored. This harvesting method can be done quickly and help prevent the kernels from damage or cracking during harvest and transportation. When harvesting with the moisture content of kernels, not exceeding 30%, the husks can help prevent the kernels from fungal and insect damages.

A.5.2.2 When harvesting by a corn snapper, the moisture content of kernels shall not exceed 30%.

A.5.2.3 When harvesting by a corn picker-sheller or a combine harvester, maize ears and kernels may be damaged, which is subsequently prone to fungal damage. Therefore, this harvesting method should be carried out when the moisture content of kernels does not exceed 22%.

A.5.3 Culling of damaged maize ears

Damaged ears, i.e., maize ears that contain kernels which are germinated, damaged by fungi, insects and other pests, or maize ears with abnormal colour and odour shall be culled from good-quality maize ears as much as possible during harvest in order to reduce the damage of the produce. This practice can result in maize with good or best quality for sale.

A.5.4 Drying

A.5.4.1 Maize drying is an important step that has to be done immediately after harvest in order to minimize contamination of aflatoxin. Drying methods should be carried out either by sun drying for 2 to 3 days or by wind drying for 5 to 7 days on the clean and dry concrete floor, or on the tarpaulin or plastic sheet, or on the stretcher raised from the ground of at least half a metre in order to reduce the moisture content of maize ears below 23%.

A.5.4.2 In case of maize kernels, they shall be distributed immediately within 24 hours. If the distribution can not be done on time, the moisture content shall be reduced to 18% within 2 days and stored not more than 3 days. If the longer period of storage is required, the storage shall be carried out in accordance with Section A.6.

A.5.4.3 In case of early harvest of maize which is planted during early rainy season, wet maize ears shall be shelled immediately after harvest. If the moisture content of maize kernels exceeds 30%, the produce shall be distributed within 24 hours.

A.6 STORAGE AND TRANSPORTATION

A.6.1 Storage

A.6.1.1 Storage area shall be well-ventilated, dry, free from insects and disease carrier animals, and not be located near the storage areas of pesticides, fertilizers, and other hazardous substances.

A.6.1.2 In case where unhusked maize ears are stored for less than one month, the required initial moisture content shall not exceed 23%. This practice would result in reducing the transmission of diseases and insect infestation, and also inhibit the formation of aflatoxins for 3-6 weeks depending on the level of mold growth.

A.6.1.3 The height of the pile of maize ears shall not be more than 1 m. There shall be air ducts under the pile, or the pile shall be gradually turned over to reduce heat accumulation.

A.6.1.4 Maize storage area shall have supporting material over the floor in order to prevent the produce from direct contact with the floor because maize will absorb the moisture from the floor, which consequently causes mold growth.

A.6.1.5 Maize ears shall be packed in containers like gunny bag. The bags shall be stacked up with adequate space between stacks, walls and ceilings. This practice will provide good ventilation and prevent maize from heat and humidity accumulation which is the factor promoting mold growth and insect infestation.

A.6.1.6 The packaging materials for maize ears or maize kernels e.g. gunny bag shall be clean and hygienic in order to be able to prevent contamination from hazardous substances and dangerous foreign matters including disease carrier animals such as rats, birds, insects or any other animals.

A.6.1.7 Average relative humidity and temperature for maize storage during the dry season shall be 65% and 25-30 °C, respectively.

A.6.2 Transportation

A.6.2.1 Vehicles for transporting maize shall be clean, tightly closed to prevent the produce from rain and contamination of hazardous substances.

A.6.2.2 During transportation, maize ears and kernels shall be packed in a moisture-proof container to prevent an increase of moisture and the consequential formation of mold.

A.7 PERSONAL HEALTH

Provide appropriate health care and preventive measures to workers such as taking them to the hospital when sick or injured, or providing them with First-Aid kits.

A.8 RECORD KEEPING

A.8.1 Availability of records for inspection and traceability as follows:

- (1) Sources of production inputs such as seeds, fertilizers and pesticides;
- (2) The use of pesticides;
- (3) Cultivating and harvesting;
- (4) Buyers or distributors of each crop of production

A.8.2 Records shall be kept for at least 2 years in order to trace back and recall the produce when there is food incident. For traceability purpose, the inspection shall be carried out in accordance with the Thai Agricultural Standard on Principle for Traceability as a Tool within an Agricultural Commodity and Food Inspection and Certification System (TAS 9028-2008).

APPENDIX B

EXAMPLE OF RECORD FORM

General information, Planting, Harvesting and Storage Practices of Maize

Year.....

1. Owner

First Name (Mr./Mrs./Miss)..... Family name

Farmer registered No. or plot No.

Identification No.

Contact address: No. Moo. Road Sub-istrict

District Province Postal Code

Telephone No. Mobile phone No.

2. Planting area

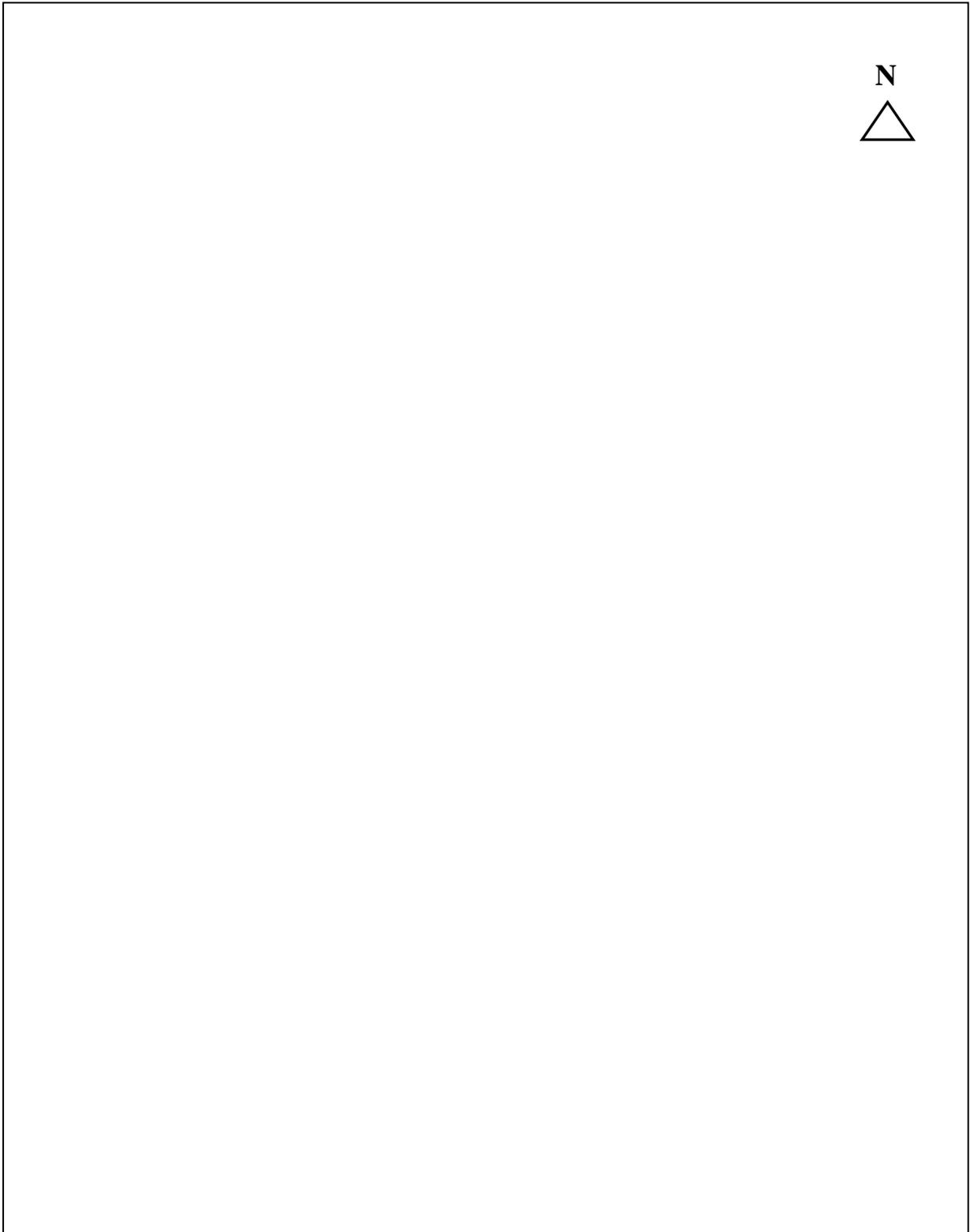
2.1 Plot location (If it is different from the contact address of owner).....

.....

Total plots Total arearai

2.2 Soil types Clay Clay loam Sandy loam Sandy Others (Specify).....2.3 Water used on farm Rain water Ground water Natural water source

Map of plot location, communication route and significant places in the vicinity for travel convenience



3. Land use history Plot No.

- 3.1 Used to be an agricultural land Year
- Idle land
- Used to be an industrial land Year
- Used to be a dumping site of refuse/waste water/waste chemicals
Year
- Used to be a hospital Years
- Others (Please specify)

3.2 Planting species in the past 1 year Name

Planting species in the past 2 years Name

3.3 Analysis of pesticide residues (the result of analysis shall be attached to this form)

3.3.1 Water

- Yes No

Date of sampling Date of delivering for analysis

- Non-detected residues Detected residues (Specify)

3.3.2 Soil

- Yes No

Date of sampling Date of delivering for analysis

- Non-detected residues Detected residues (Specify)

3.3.3 Crops (Specify)

- Yes No

Date of sampling Date of delivering for analysis

- Non-detected residues Detected residues (Specify)

4. Current cultivating practices (Planting/Harvesting/Handling/and Distribution)

4.1 Burn stubbles before planting Not burn stubbles before planting

4.2 Grow cover crops Name Date of planting

- Not grow any cover crop

4.3 Use of fertilizers

- Compost

- Manure

- Others (specify)

- Not use any fertilizer

4.4 Production inputs**4.4.1 Seeds**

Name/Commercial name	Source (Producer/Distributor)	Manufacturing date	Expiry date

4.4.2 Fertilizers/Applied Formulas

Name/Commercial name	Source (Producer/Distributor)	Manufacturing date	Expiry date

4.4.3 Pesticides

Name/Commercial name	Source (Producer/Distributor)	Manufacturing date	Expiry date

4.5 Planting and harvesting

Plot No.	Planted area (rai)	Harvested area (rai)	Seeds used (kg)	Date of planting	Fertilizer application		Date of harvesting	Production	Date of distribution
					Date of application	Amount (kg)			

4.6 Pest Control

Plot No.	Pest survey		Pest Control		
	Date	Weeds/Diseases/Insects	Pesticide names (Commercial names)/Other control measures	Date of application	Amount (kg)

4.7 Produce

4.7.1 Culling of damaged maize ears

- No culling
 Yes, in which stage:
 Harvesting Storage Distribution

4.7.2 Storage With husks Without husks Kernels

- Storage method Bulk
 Container
 Gunny bag New
 Reuse (previously contained.....)
 Plastic bag New
 Reuse (previously contained)
 Others (specify).....

Storage area

- Storage house Barn living area (dry in living area)

4.7.3 Moisture content of the produce

Duration	Date of measurement	Moisture content (%)
After harvest		
During storage		
Distribution		

4.7.4 Produce Distribution (in the previous planting season)

- Immediately after harvest day after harvest
 Sun drying fordays prior to distribution
During the drying process, there was rain day(s)
 no rain
 Oven drying at degree Celsius prior to distribution
 Other drying methods (specify).....

Produce	Amount (Kg)	Selling price per kg (Baht)	Name and address of buyer
Unhusked maize ears			
Husked maize ears			
Maize kernels			

4.7.5 Surplus and waste management

- Buried at.....
 Other methods (Specify)

5. Training of worker/responsible person

5.1 Training

Yes No

Title/program of training	Organization	Date/Month/Year

Graduated in Agriculture major

5.2 Experience

Have some experience in maize cultivation foryears

Signature of responsible person

APPENDIX C

MAIZE PESTS

Epidemic Period	Maize Pest	Control Measure
The epidemic is severe in the rainy season	<p>Sorghum Downy mildew Causal organism: <i>Peronosclerospora sorghi</i> (W. Weston & Uppal) C.G. Shaw Symptom: -The symptom starts with irregular yellow, light green or dark green stripes on maize leaves, and then it turns the whole leaf into brown colour causing leaf blight. The leaf becomes wilt and dies eventually. In the morning, a white fungal mycelium can be clearly observed on the lower leaf surface. -The infected plant has stunted growth, short internodes, narrow leaves, and malformed reproductive organs (tassels and ears), for example, elongated ears are barren or have poor seed set, inflorescences or tassels may exhibit bushy growth. Outbreak: The disease outbreak is found in all maize planting areas. Fungal spores spread from the infected plants by wind, rain and infected seeds.</p>	<ul style="list-style-type: none"> - Use resistant varieties. - Regularly conduct the field survey from the beginning of maize planting. If a maize plant exhibits the symptom of disease, the infected plant shall be pulled out and burnt immediately. - Grow the maize plants before heavy rainfall or early rainy season. - Destroy alternate hosts e.g. cleaver, sedge, reed, Saccharum grass, thatch grass including the leftovers of maize plants and germinated kernels from previous harvest.
Late rainy season when the relative humidity is high	<p>Southern Rust Causal organism: <i>Puccinia polysora</i> Underw. Symptom: - The symptom is shown by reddish brown pustules on leaf surface. The powdery orange lesions contained in the pustule resemble rust in appearance. Severely infected leaf becomes chlorotic and dry eventually. If the fungus infection occurs at the flowering stage of male plants, the maize yield will decrease 30% to 70%. Outbreak: The disease outbreak is generally found in the North, Northeast, and Central regions of Thailand. Fungal spores spread by wind.</p>	<ul style="list-style-type: none"> - Use resistant varieties - If the severe epidemic is found and the pesticide application is required, follow the instructions on the labels or the recommendations of the Department of Agriculture.
Hot weather and high humidity condition.	<p>Southern Corn Leaf Blight Causal organism: <i>Bipolaris maydis</i> (Nisikado) Shoemaker Symptom: The symptom is shown by square lesions with reddish brown borders along the length of</p>	<ul style="list-style-type: none"> - Use resistant varieties - Destroy all of the infected plant debris and alternate hosts. Keep the plots clean and free from weeds.

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	<p>maize leaf. The lesions will make the leaf sheath dry at infected areas. When the infection is severe, these lesions coalesce causing leaf blight.</p> <p>The fungus also attacks the plants during flowering and kernel formation stages resulting in the negative effect on maize yield and quality.</p> <p>Outbreak: The fungus produce spores on lesions. Spore dispersal is carried out by wind, rain and seed.</p>	<p>- If the severe epidemic is found and the pesticide application is required, follow the instructions on the labels or the recommendations of the Department of Agriculture.</p>
Throughout the growing season	<p>Northern Corn Leaf Blight Causal organism: <i>Exserohilum turcicum</i> (Pass.) K.J. Leonard and E.G. Suggs</p> <p>Symptom: The symptom is shown by large grey or brown lesions along the length of maize leaf, leaf sheath, stalk and husk. The lesion has a fusiform shape at the size of 2.5 to 20 cm in length. The lesions that appear on leaf can be both single and coalescent causing dried leaf and dead.</p> <p>Favorable environmental conditions for disease development are at high humidity and cold weather at temperature range between 18-27 °C.</p> <p>If the fungus attacks the plants before the silk emerges, the maize yield will be decreased 50%. However, if the infection occurs after the silk has emerged for 6 weeks, there will be less impact on yield. .</p> <p>Outbreak: The fungus produce spores on old lesions. Spore dispersal is carried out by wind and rain.</p>	<p>- Use resistant varieties - Destroy all of the infected plant debris and alternate hosts. Keep the plots clean.</p> <p>- If the severe epidemic is found and the pesticide application is required, follow the instructions on the labels or the recommendations of the Department of Agriculture.</p>
Throughout the growing season	<p>Common Smut Causal organism: <i>Ustilago maydis</i> (DC.) Corda</p> <p>Symptom: The causal fungus forms tumor-like galls which will turn into black colour when they are mature. Mature black spores are released from the gall by rupturing its periderm and consequently cause an epidemic for the next growing season. The formation of galls is found above the ground parts of plants, i.e.,</p>	<p>- Burn and destroy all of the infected plant debris. - Treat the seeds with fungicides before planting - Use crop rotations by planting a dissimilar crop instead of maize for 1 to 2 years in the same planting plot where the infection occurred.</p> <p>- If the severe epidemic is</p>

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	<p>stalks, leaves, ears, and tassels.</p> <p>Outbreak: The disease outbreak is found in Northern region of Thailand. Mature black spores that are released from the galls spread by wind, rain, running water, insects, animals, including seeds.</p>	<p>found and the pesticide application is required, follow the instructions on the labels or the recommendations of the Department of Agriculture.</p>
<p>Hot weather with high relative humidity (90% to 100%)</p>	<p>Banded Leaf and Sheath Blight Causal organism: <i>Rhizoctonia solani</i> Kühn.f. sp. <i>sasakii</i> Exner. Symptom: The causal fungus lives in soil and dead alternate host plants inside the plot. If an infection occurs during seedling stage, the seedling will become rotten. In natural condition, an infection is found on the lower leaves near soil surface. The symptom is shown by water-soaked lesions varying in size on the basal part to the middle part of the maize leaf. The lesions will turn pale or straw colour and spread along the leaf causing dried leaf that looks like sunburn. The symptom also appears with brown concentric bands and rings on the leaf area.</p> <p>Lesions on the sheath and leaf are similar, while lesions on the stalk appear under the infected sheath and display in dark brown or black colours. When the lesions subside or dry, they leave dark brown scales on which the white compact mycelia develop and turn into dark brown sclerotia.</p> <p>Outbreak: The disease outbreak is found in all maize planting areas.</p>	<ul style="list-style-type: none"> - Use resistant varieties - Use the seeds produced from robust and disease-free plants. - If the severe epidemic is found, the infected plant shall be pulled out and burnt. - Avoid the intensive planting and reduce the application of nitrogen fertilizers. - Increase the quantities of organic matters and antagonistic microorganisms in the plot. - Destroy the maize plants that are left over from harvest and plough the soil for proper drainage.

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Year round	<p>Maize Dwarf Mosaic</p> <p>Causal organism: Maize dwarf mosaic virus (MDMV) or Sugarcane Mosaic Virus (SCMV), and Maize Chlorotic Mottle Virus (MCMV)</p> <p>Vector: <i>Rhopalosiphum maidis</i> (Corn leaf aphid)</p> <p>Symptom:</p> <ul style="list-style-type: none"> - The symptom starts with the chlorotic spots on the base of young leaflet. These spots later develop short chlorotic streaks parallel to the veins. - The infected leaf develops a distinct mosaic having the mottled area of pale green and dark green colours, and yellow spots. - If the infection occurs during seedling stage, there may be severe stunting of the plant. As plants approaching maturity, the foliage can turn purple or reddish purple. - The combination of MDMV and MCMV infections is characterized by mosaic appearance, leaf blight, and bud necrosis. - Tassels become malformed or barren. Ears are nubbin with poor seed set or no ear at all. Husks are dry. <p>Outbreak: The disease outbreak is found in all planting areas. The virus can be transmitted through farming equipment.</p>	<ul style="list-style-type: none"> - Use resistant varieties - Destroy all of the infected plants as well as alternate hosts which are the source of infection such as sugarcane or sorghum that show any symptom of disease. - Destroy aphids - Use crop rotations
High humidity condition	<p>Stalk Rots</p> <p>Causal organisms: Fungi (e.g. <i>Fusarium moniliforme</i> Sheld., <i>Macrophomina phaseoli</i> (Maubl.) Ashby, <i>Diplodia maydis</i> (Berk.) Sacc.) and Bacteria (e.g. <i>Erwinia chrysanthemi</i> pv. <i>zeae</i>)</p> <p>Symptom</p> <ul style="list-style-type: none"> - An infection of this disease starts from the root system from which stalk rotting organisms spread to the internode. The infected internode tissues become discoloured. The plant is prone to lodging. - This disease frequently occurs in the stages of mature stalk to flowering stage. <p>Outbreak The disease outbreak is found in all maize</p>	<ul style="list-style-type: none"> - Destroy all of the infected plant debris. - Do not overuse nitrogen fertilizers. - Avoid the intensive planting. - Use organic fertilizers for soil fertility improvement.

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	planting areas. The spores will spread through wind and rain.	
Rainy season or high relative humidity condition	<p>Ear and Kernel Rots Causal organism: <i>Diplodia maydis</i>, <i>Fusarium moniliforme</i>, <i>Nigrospora oryzae</i>, <i>Penicillium oxalicum</i>, <i>Botryodiplodia theobromae</i>, <i>Rhizoctonia solani</i> and <i>Aspergillus</i> spp.</p> <p>This disease is prone to occur in maize plants that are infected with stem rot disease. The causal fungi damage ears and kernels.</p> <p>Symptom: Rotten ears, rotten kernels varying in colours such as white, yellow, pink or black depending on the causal fungi</p> <p>Outbreak: This disease develops by means of improper storage and harvesting practices that are carried out either in raining and high relative humidity conditions or when maize is still immature and contains high moisture content. The disease outbreak is found in all planting areas. The spores will spread through wind, rain, insect and animals.</p>	<ul style="list-style-type: none"> - Do not leave maize plants standing in the field after maturity for a long period of time. - Completely dry the maize ears before shelling. - Separate the maize ears that are damaged by disease. - Decrease the moisture content in maize kernels below 15% before storage.
The epidemic is severe in dry weather and dry spell.	<p>Corn Thrips Scientific name: <i>Frankliniella williamsi</i> Hood, <i>Caliothrips</i> sp. and <i>Thrips hawaiiensis</i> (Morgan) Adult thrips are black with two pairs of wings. They are often found in leaf-sheath axils and inflorescences, suckling the sap from them.</p> <p>Symptom: The infested leaf shows the pale yellow mottling and later becomes wilt and dies eventually.</p> <p>Outbreak: The outbreak occurs in every stage of maize planting.</p>	<ul style="list-style-type: none"> - Inspection of young leaf bases, leaf-sheath axils, and inflorescences. If the severe infestation is found and the pesticide application is required, follow the instructions on the labels or the recommendations of the Department of Agriculture.
The epidemic is severe in dry weather and dry spell.	<p>Corn Leaf Aphids Scientific name: <i>Rhopalosiphum maidis</i> (Fitch) Symptom and damage: Aphid larvae and adults feed by sucking sap from leaves, plumules, and tassels, causing curly leaf. If the infestation is severe, the tassels will become wilt and weak, and will not develop to flowering stage. Prior to severe infestation of Corn Leaf Aphids, the numbers of ants feeding</p>	<ul style="list-style-type: none"> - Normally, the population of corn leaf aphids is naturally controlled by several parasitic insects e.g. six-spotted ladybird beetles, ladybeetles, and earwigs. If the infestation of Corn Leaf Aphids is found during tassel development, appropriate

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	<p>on sweet excretion from aphids are often observed as well as the formation of black sooty mold on the infested plants. Aphids cause the most damage when they attack during the tassel formation stage.</p> <p>Outbreak: The insect outbreak is found in all planting areas.</p>	<p>control measures shall be carried out.</p> <p>If the severe infestation is found and the pesticide application is required, follow the instructions on the labels or the recommendations of the Department of Agriculture.</p>
Throughout the growing season	<p>Asian Corn Borer Scientific name: <i>Ostrinia furnacalis</i> (Guenee)</p> <p>Adults are moths with a wingspan of approximately 3 cm. Anterior pair wings are copper colour with transverse wavy lines at the edges and the bases. Two tiny black spots are at the middle of each anterior wing.</p> <p>Posterior pair wings have lighter colour than anterior pair wings and almost have no spot or pattern.</p> <p>Eggs are deposited in clusters overlap like fish scales. Larvae have creamy pink bodies with spots on each body segment. Mature larvae are approximately 20 mm long.</p> <p>Symptom and damage: Larvae begin boring into the top leaves, tassels, and stalk, and destroy in every stage of the plant growth. Asian corn borers cause the most damage when they attack during the tassel formation stage.</p> <p>Outbreak: The insect outbreak is found in all planting areas.</p>	<p>- Normally, the population of Asian Corn Borer is controlled by natural enemies such as <i>Trichogramma spp.</i> and earwigs which will feed eggs and larvae of Asian Corn Borer and result in the prevention of an outbreak. Yet, antlions and spiders also feed the young and adult larvae of Asian Corn Borer in the maize field.</p> <p>- If the severe infestation is found and the pesticide application is required, follow the instructions on the labels or the recommendations of the Department of Agriculture.</p>

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Throughout the growing season	<p>Corn Earworm Scientific name: <i>Heliothis armigera</i> (Hubner) Mature larvae have stripes varying from light green to nearly black along their bodies. The colour depends on the environment, larval age and molting. Mature larvae or moths usually harbour in the leaf axils. Symptom and damage: Larvae are the only stage that damages maize ears. Larvae feed on silk and then bore into the ear tip. If the infestation occurs before the ears are fully pollinated, ears are resulted in poor seed setting. Outbreak: The insect outbreak is found in all planting areas.</p>	<ul style="list-style-type: none"> - Natural enemies of Corn earworm eggs are <i>Trichogramma spp.</i>, and natural enemies of Corn earworms are Tachinid flies and Camerons. Whereas, natural enemies of both Corn earworms and their eggs are Antlions. - If the pesticide application is required, follow the instructions on the labels or the recommendations of the Department of Agriculture.
The epidemic is severe in late rainy season	<p>Ground Weevil Scientific name: <i>Calomycterus</i> sp. Ground weevil is the pest living in soil. Adult is a small beetle with rough blackish brown and grey skin. The length of body is 3.5 mm. Eggs are white, oblong in shape and deposited singly. During daytime, beetles usually harbour in the soil near the maize plants, especially newly germinated seedlings, and come out for feeding after nightfall. Symptom and damage: The beetles feed on maize leaves and seedlings including newly germinated seeds. They cause damage and kill seedlings. The seedlings that survived from the damage will become stunted and branched out, causing an uneven maturity of maize, malformation of ears or barrenness. Outbreak: The insect outbreak is found in all planting areas.</p>	<ul style="list-style-type: none"> - In an area where the infestation of Ground Weevil is reported, seeds should be treated with insecticides for weevil before planting. - If the severe infestation of weevil is found, i.e., the damaged leaves is higher than 50% and the damaged leaf area is higher than 30%, and the pesticide application is required, follow the instructions on the labels or the recommendations of the Department of Agriculture.
Dry season especially in an area where there	<p>Rats e.g. mice, rice-field rats and guinea pigs Symptom and damage: Rats feed on maize leaves and seedlings</p>	<ul style="list-style-type: none"> - Cultural practices, i.e., destroying rat shelters. - Biological methods by

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is no other food plant	<p>including newly germinated seeds. They cause damage and kill seedlings. The seedlings that survived from damage will become stunted and branched out, causing an uneven maturity of maize, malformation of ears or barrenness. The rats also destroy the maize during harvesting time</p> <p>Guinea pigs (<i>Bandicota</i> spp.), attack the maize trunk and cause the plants fall down and feed on maize ears.</p> <p>Black rats, rice-field rats, lesser rice-field rats (members of the <i>Rattus</i> genera) and house mice (member of the <i>Mus</i> genera) climb up the plants and feed on maize ears.</p> <p>Outbreak: The outbreak is found in all planting and storage areas.</p>	<p>means of natural enemies e.g. owls, birds, dogs, cats etc. by breeding and releasing these animals into the maize field.</p> <p>- If the pesticide application is required, follow the instructions on the labels or the recommendations of the Department of Agriculture.</p>

APPENDIX D**UNITS**

The units and symbols to be used in this Thai Agricultural Commodity Standard are the following recognized SI (The International System of Units or *Le Système International d'Unités*) units:

Type of Measurement	Name of Unit	Symbol
Length	millimetre	mm
	centimetre	cm
	metre	m
Temperature	degree Celsius	°C