



THAI AGRICULTURAL STANDARD

TAS 4405-2012

**GOOD POSTHARVEST PRACTICES FOR
MAIZE**

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

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National Bureau of Agricultural Commodity and Food Standards

Ministry of Agriculture and Cooperatives

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Maize or corn is one of the important economic crops in Thailand since it is the raw material for food processing and animal feeding. Therefore, the quality and safety of maize production is essential. The Ministry of Agriculture and Cooperatives has issued two Thai Agricultural Standards concerning maize namely: TAS 4002, Thai Agricultural standard on Maize and TAS 4402, Thai Agricultural standard on Good Agricultural Practices for maize. To ensure the entire process is covered, the Agricultural Standards Committee deems it necessary to establish the standard for Good Postharvest Practices for Maize in order to improve its quality as well as to build up confidence and safety of such commodity.

This standard is based on the information of the following document:

Department of Agriculture, Ministry of Agriculture and Cooperatives. 2004. Maize.



NOTIFICATION OF THE MINISTRY OF AGRICULTURE AND COOPERATIVES

SUBJECT: THAI AGRICULTURAL STANDARD:

GOOD POSTHARVEST 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 for Good Postharvest Practices for Maize as a voluntary standard in accordance with the Agricultural Standards Act B.E. 2551 (2008) to promote such agricultural commodity to meet its standard on quality 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 Agricultural Standard: Good Postharvest Practices for Maize (TAS 4405-2012), as a voluntary standard, details of which are attached herewith.

Notified on 6 July B.E. 2555 (2012)

(Mr. Theera Wongsamut)
Minister of Agriculture and Cooperatives

Thai Agricultural Standard

Good Postharvest Practices for Maize

1. SCOPE

This standard covers post harvest practices of maize from receiving, threshing or shelling, moisture reducing, packaging, and storing to delivering.

2. DEFINITION

The definitions used herein refer to the standards of TAS 4002, Thai Agricultural Standard for Maize, and TAS 4402, Thai Agricultural Standard on Good Agricultural Practices for Maize.

3. REQUIREMENTS AND INSPECTION METHODS

Requirements and inspection methods shall be as in Table 1

Table 1. Requirements and Inspection Methods

(Section 3)

Items	Requirements	Inspection methods
1. Establishment 1.1 Location	1.1 Shall be located in an environment with minimal risk from any contamination and not impact the likelihood of the community.	1.1 Inspect environment and preventive measures.
1.2 Building and Operation areas	1.2.1 Building and operation areas shall be strong and safe for workers.	1.2.1 Inspect the building structure and operation areas and/or interview supervisor.
	1.2.2 Design and layout of the operation areas shall be clearly separated with single flow.	1.2.2 Inspect the operation areas.

Items	Requirements	Inspection methods
	1.2.3 The floor shall be smooth, clean without any water logging. If it is not a concreted floor, it shall be paved with certain materials that can prevent contamination from the ground.	1.2.3 Inspect the operation areas.
	1.2.4 The operation area shall be provided with good air flow and adequate lighting.	1.2.4 Inspect the operation areas.
1.3 Machinery equipment, and tools	1.3.1 The type, capacity and number shall be appropriate for the production.	1.3.1 Inspect the machinery, equipment and tools as well as record.
	1.3.2 The machinery, equipment and tools shall be strong, durable and made of appropriate materials which do not cause harmful contamination in the production line. There shall be no contamination from fallen parts.	1.3.2 Inspect the machinery, equipment and tools and check preventive measures.
	1.3.3 The machinery, equipment and tools shall function properly.	1.3.3 Inspect the condition of the machinery, equipment and tools according to their manuals.
	1.3.4 Calibrate the scales and moisture meter at least once a year.	1.3.4 Check the adjustment report or results of the calibration.
2. Operation Control 2.1 Purchasing	2.1 The notice of purchasing with specifications shall be clearly posted and quality shall be checked before purchasing.	2.1 Check the notice and record concerning product quality or interview workers.

Items	Requirements	Inspection methods
2.2 Storage of maize ears prior to threshing.	2.2 Maize ears shall be stored in the clean storage house with good air flow, humidity control, water protection, damage control from pets, store pests and disease carrier animals, or any contamination that may be harmful to consumers. The storage practices shall refer to TAS 4402, Thai Agricultural Standard on Good Agricultural Practices for Maize (Section 6.1).	2.2 Inspect the storage house and preventive measures.
2.3 Threshing or shelling of maize ears	2.3.1 The condition and precision of threshing machine shall be checked every time before use to reduce breakage of the grains .	2.3.1 Check the record of operation or working manual.
	2.3.2 The supervisor shall have the knowledge or be trained on the appropriate operation of the threshing machine, which relates to the moisture content of grains and speed setting.	2.3.2 Check training record, working record, and/or interview supervisor.
2.4 Moisture reduction	2.4.1 The moisture content of grains shall be reduced to not more than 18% within 48 h (hour) and the grains shall be stored for not more than 3 days.	2.4.1 Check record of moisture reduction or randomly check grain quality and interview workers.
	2.4.2 The moisture content of grain shall be reduced to less than 14% for a three months storage or less than 13% for a 12 months storage.	2.4.2 Check the record of storage or randomly check grain quality and/or interview workers.
	2.4.3 Dust and dirt shall be blown out from grains before and after the moisture reduction.	2.4.3 Check the operation record

Items	Requirements	Inspection methods
	2.4.4 During the process of moisture reduction, grain samples shall be randomly checked for moisture content periodically.	2.4.4 Check record of drying temperature and interview workers.
	2.4.5 After drying process, the grain shall be rest until reaching the ambient temperature. The grains shall then be traded or stored.	2.4.5 Check operation record
2.5 Packing	2.5.1 Grains shall be packed according to the quality classes as referring to TAS. 4002.	2.5.1 Inspect the operation.
	2.5.2 Prevention of metal, glasses, plastic or chemicals contaminations during packing shall be provided.	2.5.2 Check the operation and contamination preventive measures.
	2.5.3 The containers shall be clean, and ready to be used. The used containers of hazardous substances shall be prohibited.	2.5.3 Check the operation and preventive measures.
2.6 Selling or storing for sale.	2.6.1 Grains shall be separated according to quality classes with clear identification tag.	2.6.1 Visual inspection of the storage house.
	2.6.2 Grains shall be stored separately from pesticides, fertilizer or other chemicals which may be harmful for consumption.	2.6.2 Visual inspection of the storage house.
	2.6.3 Grains shall not be piled or placed directly on the floor without moisture-proof materials.	2.6.3 Visual inspection of the storage house.
	2.6.4 The storage facilities and stored grains shall be checked periodically at least once a week.	2.6.4 Check record and visually inspect storage facilities.

Items	Requirements	Inspection methods
	2.6.5 The fumigants and methods of fumigation shall be complied with the recommendations of the relevant government agency.	2.6.5 Check record of or inspect the operation
3. Sanitation and Maintenance		
3.1 Cleaning	3.1 Machinery, equipment and tools and operation areas shall be cleaned after work daily.	3.1 Inspect work areas, work plan and cleaning record.
3.2 Prevention of pets store pests and disease carrier animals	3.2 Prevention of pets, store pests and disease carrier animals shall be provided.	3.2 Inspect work areas
3.3 Management of waste or debris or unrelated items to production process	3.3.1 Unqualified ears/grains shall be culled off from the good quality ones to prevent adulteration.	3.3.1 Inspect work areas, check operation record, and/or interview workers.
	3.3.2 Waste and garbage shall be kept in an assigned area, away from the production area and disposed sanitarly.	3.3.2 Check operation record, and/or interview workers.
3.4 Maintenance	3.4 Machinery, equipment and tools shall be maintained in good condition and ready to be used.	3.4 Check work plan and maintenance record.
4. Personal hygiene	4. Operators and visitors entering into the production area shall maintain the hygienic practices.	4. Check the procedures concerning personal hygiene
5. Transportation	5. Vehicle for grain transportation shall be clean and have never been used to transport hazardous substances. The vehicle shall be able to tightly covered with waterproof materials.	5. Inspect the vehicle and check cleaning record.

Items	Requirements	Inspection methods
6. Training	<p>6.1 The training course on good hygienic practices and on food safety shall be provided to workers and relevant personnel.</p> <p>6.2 Suitable training courses shall be provided to personnel according to their responsibilities.</p>	<p>6.1 Check training records.</p> <p>6.2 Check training records and/or interview workers.</p>
7. Record keeping	<p>7.1 The following data shall be recorded:</p> <ol style="list-style-type: none"> 1) General information of entrepreneur 2) Work operation control 3) Sanitation and maintenance 4) Adjustment and calibration of machinery/equipment/ and tools 5) Grain transportation. 6) Training <p>7.2 Record shall be kept for at least 2 years.</p>	<p>7.1 Check records and details as in Appendix B.</p> <p>7.2 Check records</p>

Appendix A

Guidance on Good Postharvest Practices for Maize

(Section 4)

A 1 Establishment

A 1.1 Location

A 1.1.1 Building location shall be distant away from polluted sources, haze, hazardous dust, or odorous areas. The area shall not be prone to flooding and not impact the likelihood to the community.

A 1.1.2 Road and pavement around buildings shall be made of asphalt, concrete, or paved with durable materials that can withstand working conditions, and be well drained and cleaned as necessary.

A 1.2 Buildings and operation area

A 1.2.1 Construction materials shall be strong and durable; easily cleaned, fixed and maintained; and not causing contamination and/or alteration in grain quality.

A 1.2.2 Design and layout

1) The production line shall be continuous flow, single direction starting from loading dock, to the finishing point where grain grains are ready for trade.

2) Work areas shall be orderly segregated such as housing, production area, toilet; hazardous area such as chemical storage, general and toxic garbage disposals. The numbers of garbage disposal and toilet shall be sufficient. The toilet in the building, if necessary, shall not have the entry-exit directly to the pile of grains.

3) There shall be drains and rainfall protection facilities.

4) Provided with safety precaution such as availability of light bulb cover, drainage cover and entry-exit control of each building.

5) Provided with easy and convenient cleaning and/or maintenance without dust and water accumulation at the corner or joints between the edges. There shall be enough space between the building wall and machinery, equipment, and tools. The height of the ceiling or the roof shall be high enough for forklift operation.

6) Operation areas, e.g. drying facilities, drier and storage shall be provided with good preventive measures against pets, store pests and disease carrier animals such as dogs, birds, rodents and cockroaches that may cause damage or contamination to produce.

7) Working surface shall be smooth and slightly slope to prevent waterlogging.

A 1.2.3 Buildings shall be provided with good air flow, optimal temperature and light intensity to prevent adverse effect on grain quality and health of workers. The optimal light intensity shall be appropriate for working conditions such as footpath and general area 50 and 100 lux, respectively.

A 1.3 Machinery, equipment and tools

- A 1.3.1 There shall be sufficient in numbers, types, and capacity suitable for production and ready for use;
- A 1.3.2 Materials used shall be strong and durable, easy to clean or maintain, and shall not cause contamination and/or alter grain quality;
- A 1.3.3 Design and installation shall facilitate cleaning, repairing and maintenance easily and conveniently;
- A 1.3.4 Equipment and tools used in production shall be inspected for proper operation;
- A 1.3.5 Scales and moisture meter shall be inspected for accuracy by accredited certification body at least once a year.

A 2 OPERATION CONTROL**A 2.1 Purchasing**

- A 2.1.1 There shall be a clear notice on purchased specifications. Samples shall be randomly checked for grain quality prior to purchasing.
- A 2.1.2 Cull and dispose of damaged ears. In case the disposing process cannot be done within the day, such culled ears shall be piled separately or stored in the container with the tag showing "to be disposed". Such culled ears shall not be kept for long, as they may cause disease spreading.

A 2.2 Storage of maize ears prior to threshing

- A 2.2.1 Maize ears storage shall be practiced as follows:
 - 1) Awaiting maize ear bags for threshing shall not be placed directly on the floor but on pallet to prevent moisture absorption from the floor. The stack of bags shall be provided with enough space for good air flow and walk-through inspection.
 - 2) In case of bulk storage, the storage floor shall be paved with waterproof materials or the floor shall be designed in a manner that can prevent maize ears/ grains from absorbing moisture from the floor.

A 2.3 Threshing or shelling of maize ears

- A 2.3.1 Accuracy of the threshing machine shall be checked every time before use.
- A 2.3.2 Supervisor shall be trained or know how to operate the threshing machine in order to minimise breakage of grains grain.
- A 2.3.3 To minimise breakage of grains grain during threshing, the grains shall be threshed at the moisture content of 22-26%. The speed of the cracking part (cracker) shall be adjusted to 8-12 m/s (meter per second). Usually the round speed is based on maize ear moisture content.

A 2.4 Moisture reduction

Three methods of moisture reduction are commonly used as follows:

- 1) air-dried or sun-dried

In case drying grains on the ground, such ground shall be covered with clean mat or plastic. In case of drying on concreted floor, the floor shall be slightly bulgy including

drainage ditches around such floor. The grains shall be spread out evenly or turned over once every hour in order to speed up the moisture reduction. Such method is better than the non turn-over method by 67%.

2) fan blower

The air pipe shall be used in silo. For the capacity of 5,000 kg silo, the pipe shall be inserted into the middle of the silo for uniform air flow at all directions. During raining with high relative humidity, the blower shall not be operated except using hot forced air.

3) oven

The temperature and flowing speed shall be properly adjusted corresponding to the target moisture content. For instance, for very high moisture grains, the initial temperature of 90-120°C may be applied and adjusted to lower temperature when the moisture has been decreased.

In addition, grains shall be grouped into the same batch if the differences of moisture content are between 1-3%. For low moist grains, the difference of 1% shall be practiced.

The details on moisture reduction are as follows:

A 2.4.1 After threshing, if it is not yet traded, moisture content shall be reduced to not more than 18% within 48 hours and be stored not exceeding 3 days. If not doing so, grains shall be fumigated with carbon dioxide to maintain the quality for more than 10 days. The procedures are as follows:

1) Pile the grains on smooth concreted floor with the edge of the pile at least 1 meter away from the wall. The surface of the pile shall be spread evenly to minimise the gap between pile surface and covered plastic so as to safe fumigant. The pile size depends on the size of covering plastic.

2) Cover the pile with the same plastic used in fumigation, or Polyvinyl chloride (PVC) sheet with the thickness of 0.10 mm. or more (do not use torn PVC). Then press the edge of covered plastic with rolls of empty sacks (10 sacks per roll) or sand bags to prevent air exchange.

3) Fumigate the pile with 0.5 kg. CO₂ per 1,000 kg. of grain starting from any side of the pile by extending the hose end from gas tank and insert the other end into the pile for 15 – 20 cm. depth. Then release the certain amount of gas as required. Pull out the hose and neatly cover the edge of plastic with the prepared roll of empty sacks or sand bags. If air vacuum is used, air inside the pile shall be expelled before fumigation, the recommended rate of CO₂ shall be lower to 0.3 kg. per 1,000 kg. of grains.

A 2.4.2 In case of storing for more than three days, grains moisture content shall be reduced to the required level, for instance less than 14% moisture content for 3 month-storage and less than 13% moisture content for 12 month storage.

A 2.4.3 Dust or dirt from grains shall be blown out before and after moisture reduction or at any step where possible. Defected or damaged grains and the foreign matters such as gravels shall be sorted out.

A 2.4.4 Samples shall be randomly drawn periodically during moisture reduction process in order to check if the targeted moisture has achieved. The samples collected shall be cooled down to ambient temperature before testing.

A 2.4.5 After moisture reduction process, the heated grains shall be cooled down to room temperature, approximately 24 hours before trade or storage. In this practice, the moisture content may be further reduced by 1%.

A 2.5 Packing

A 2.5.1 Before packing, the grains shall be graded and identified according to TAS. 4002.

A 2.5.2 Packing shall be operated under controlled conditions to prevent contamination .

A 2.5.3 The description of container packages and/or storage including silos and transported containers shall be as follows:

1) Clean and hygienic to ensure prevention of grains from hazardous substances , foreign matters that may cause harmful effects, contamination caused by disease carriers animal such as rodent, insects, birds including other animals. In case of reuse container, proper cleaning and drying shall be done before packing to ensure no tainted chemicals or contaminants

2) There shall be labels or tags showing the status of the production processes such as dates of purchasing, date of production, quality class, damaged grains, and to-be-disposed garbage.

3) Filled containers shall be identified with clear label or tag with the information including name and address of producer, batch number, date of production and quality class.

A 2.6 Selling or storing for sale A 2.6.1 Arrangement of containers in the storage shall be as follows:

Storage and methods of storage shall be provided with good air flow in order to prevent heat and humidity accumulation. Before storing the grains, the place shall be cleaned and fumigated to eradicate store pests. Grains or their containers shall not be piled or placed directly on the floor where there is no prevention against moisture or moisture can be absorbed from the ground. In the case of storing grains in sacks, they shall be supported by pallet or materials that prevent moisture absorption from the floor. The bags shall be piled up in stack and provided enough space between stacks. The stacks shall be away from the ceiling, drainage ditch and rain gutters to allow good air flow and to facilitate cleaning and inspection. Stored grains shall be periodically checked for damages including harbouring of disease carrier animals for further corrective actions. In case grains are stored for more than one month, fumigation shall be applied according to proper procedure.

A 2.6.2 Clearly separate the storage of grain from agricultural hazardous substances, fertilizer or other chemicals which may be harmful for consumption.

A 2.6.3 Types and methods of storage

1) Piling grains on the floor, the grains shall not be piled too high, and not close to the wall to allow good air flow. The pile shall be periodically turned over to reduce internal

temperature. Another method to reduce the internal temperature is to insert a pipe into the pile to help the release of heat or use as a mean to blow dried air into the pile.

- 2) In case of silo storage, appropriate ventilation system shall be provided.
- 3) The stack of sacks shall not be higher than 30 sacks and allow the height between the top sack and ceiling not less than 1.5 meters; leave the spacing between the stack and the wall, and spacing between each stack shall not be less than 1 meter for walking space.. The main entrance of the storage shall not be less than 1.5 meters in width.
- 4) Data of the storage shall be recorded for each lot such as date of production and specific procedures applied to such lot for traceability.
- 5) Do not store grains with the difference of more than 5°c to the ambient temperature. The moisture content of grains stored in the same lot shall be of similar level but below 14%. The former lot shall not be mixed with the new arrival.
- 6) To store grains for more than 1 year, the moisture content of the grains shall be maintained below 13%.

A 2.6.4 Storage shall be regularly checked for temperature and air flow. Periodical inspection of stored grains shall be practiced as follows:

- 1) Grains shall be checked for quality at least once a week. In case of long grain storage, the weekly observation of the changes of grains such as moldy grains, moisture content in containers, abnormal odour, and abnormal high temperature spot shall be checked. If the problems are found, the following actions shall be applied, such as reducing the temperature by ventilation, exposing the high temperature spot for better ventilation, or removing damaged grains. Sampling and testing of grain quality shall be done periodically along the storage time.
- 2) Inspection and control of hazards caused by moisture in all aspects, such as the water drip from air conditioner, damp or wet wall or floor, or the condensation on packaging due to the transfer from cold storage to the warmer area.

A 2.6.5 Permitted pest control methods for food industry shall be applied. If such methods involved hazardous chemicals, permitted service provider may be hired. For instance, if store pest is found, fumigation with the rate of 2 kg. of CO₂ per 1,000 kg. of grains shall be applied for 15 days. In case chemical fumigant is used, the application shall be complied with recommendation of the Department of Agriculture.

A 3. SANITATION AND MAINTENANCE

A 3.1 Cleaning

- 1) Check and maintain machinery, equipment and tools. Workplace, both inside and outside the buildings, shall be cleaned without waterlogging area.
- 2) Machinery, equipments and tools including work area shall be cleaned after work daily. If necessary, the cleaning shall be done before working.
- 3) Avoid using water to clean equipment, tools or work area in order to minimise wet spot or accumulation of moisture in the work area which is the major factors for fungus growth and contamination. If water is used, it shall be done with care to prevent grains from dampness.
- 4) Chemical used in cleaning shall be those approved for food industry.

5) Changing areas for clothes and shoes including rest rooms (toilet) shall be in order and cleaned at all time.

A 3.2 Prevention of pets, store pests and disease carrier animals

A 3.2.1 Control method shall be complied with the approved method for food industry. Hazardous substances shall be used under the recommendations of the competent authorities.

A 3.2.2 Inspection and monitor of store pests shall be regularly done, at least once a week.

A 3.3 Management of waste, debris or unrelated items to production process

A 3.3.1 Unquality maize ears and grains shall be culled off. In case of mold, it shall be destroyed .

A 3.3.2 Waste and garbage

1) Wastes, debris or unrelated items to production process shall be collected according to the identified bins. Promptly remove those bins to the disposal area after daily work.

2) Hazardous substances handling:

The hazardous substances such as pesticides or flammable substances shall be clearly labelled and described of their harmful properties. Those substances shall be kept in the lockable cabinet or place. The record of checking in/out or used by responsible persons shall be kept.. There shall be measures to prevent the contamination of such substances in the storage.

A 3.4 Work areas, machinery, equipment and tools shall be checked and maintained on weekly basis to ensure the normal use.

A 4 PERSONAL HYGIENE

A 4.1 Workers shall practice as follows:

1) Worker recruitment, they shall be required with health check up and medical certificate indicating no contagious diseases.

2) Workers responsible in the storage shall be trained on basic sanitation such as personal cleanliness.

3) Workers shall be occasionally provided with health check up and monitoring contagious diseases, such as diarrhea, wound infection. Sick workers shall be allowed to take sick leave immediately.

4) Shoes and clothes shall be changed before operation or entering to the production area.

A 4.2 Visitors entering to the work area shall practice as follows:-

1) Follow the personal hygienic practices as instructed by the company

2) Walk on the assigned track and under the supervision of the responsible person.

A 5. TRANSPORTATION

A 5.1 The specification of vehicles for grains transportation shall be as follows:-

A 5.1.1 Strong, durable and appropriate for grain transport and the loading cargo area can be easily cleaned

A 5.1.2 Clean and not causing contamination, for instance, never been used to carry hazardous substances, such as chemicals.

A 5.1.3 Cargo area shall be able to tightly covered with waterproof materials and allow good air flow.

A 5.2 Transportation of high moisture grains, over the TAS. 4002, shall be rapidly delivered to prevent rottenness or quality deterioration.

A 6. TRAINING

A 6.1 Each worker shall be trained of his own duty on postharvest practices, basic hygiene and food safety.

A 6.2 Machines operator, quality control officer and workers concerning hazardous substances use shall be provided with additionally training due to their duties and responsibilities.

A 7. RECORD KEEPING

A 7.1 Records are as follows:-

- 1) general information of entrepreneur
- 2) operation control
- 3) sanitation and maintenance
- 4) adjustment and calibration of machinery , equipment and tools
- 5) grain transportation
- 6) training and personal hygiene check-up
- 7) history of machinery s, equipment and tools

A 7.2 Records shall be kept at least for two years. The record of workers, machinery, equipment and tools shall be kept throughout the years of operation.

A 7.3 Production process shall be recorded in details. Documentation or forms of each production batch shall be updated. There shall be signatures of workers and supervisors in the record for every recording, besides the record keeping.

PRODUCTION RECORD**THRESHING****Production date***

Lot Number	Quantity (metric ton)			Percentage (%)		Remark
	Maize ear	Culled off ear	Grains	Moisture content	Broken grains	

DRYING REPORT

Date	Time(am/pm)	Temperature (°c)	Moisture content (%)	Remark

