

# PHILIPPINE NATIONAL STANDARD

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## Code of practice for the prevention and reduction of aflatoxin contamination in corn



### **BUREAU OF AGRICULTURE AND FISHERIES STANDARDS**

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## **Foreword**

The Philippine National Standard (PNS) Code of practice for the prevention and reduction of aflatoxin contamination in corn (PNS/BAFPS 27:2008) was developed to provide uniform guidance for all corn stakeholders, as well as serve as common reference and basis for compliance to Good Agricultural Practices (GAP) for corn. This code provides adequate measures to manage aflatoxin contamination in the supply chain following the framework of farm to table approach to food safety. It also provides guidance to all persons involved in producing and handling corn intended for human and animal consumption for entry into local and international trade.

In 2017, the Bureau of Agriculture and Fisheries Standards (BAFS) took the initiative to revise the Standard to account for results of recent studies and advances for the prevention and reduction of aflatoxin contamination in corn. This revision is in accordance with the protocol of the Bureau's Standards Development Division (SDD) to review and, if applicable, revise standards every two (2) years, especially those that pose risk to consumer safety and health. A Technical Working Group (TWG) for the revision of the Standard was created and authorized under Special Order No. 523 Series of 2017. The TWG was composed of the following agencies and institutions: National Food Authority (NFA), National Food Authority – Food Development Center (NFA-FDC), Bureau of Animal Industry (BAI), Food and Nutrition Research Institute (FNRI), Philippine Center for Postharvest Development and Mechanization (PHilMech), University of the Philippines Los Baños (UPLB), and Department of Agriculture (DA) – Corn Program.

This document was drafted in accordance with the editorial rules of the BPS Directives, Part 3.

This Standard cancels and repeals PNS/BAFPS 27:2008.

## **1 Scope**

This document is intended to provide guidance to all persons involved in producing and handling corn for entry into local and international trade intended for human and animal consumption. This code constitutes from on-farm production to on-farm/off-farm storage. This code of practice recommends measures that should be implemented by all persons that have the responsibility of assuring that food and feed are safe from aflatoxin.

## **2 Normative references**

The following document, in whole or in part, is normatively referenced in this document and is indispensable for its application.

*PNS/BAFPS 20:2008, Good Agricultural Practices (GAP) for Corn or its latest issuance*

## **3 Terms and definitions**

For the purposes of this Code, the following terms and definitions apply.

### **3.1**

#### **aflatoxin**

group of highly poisonous and carcinogenic compounds which are produced by strains of the fungi, *Aspergillus flavus* Link and *Aspergillus parasiticus* Speare on suitable substrate such as corn, peanuts, copra, and other oilseeds, etc. Aflatoxin content is expressed in µg/ kg

### **3.2**

#### **corn stakeholders**

includes corn farmers, traders and users

### **3.3**

#### **corn**

corn on cob and shelled corn of *Zea mays* L.

### **3.4**

#### **foreign matter**

all matters other than corn grains such as sand, gravel, dirt, pebbles, stones, lumps of earth, clay mud, chaff, straw and seeds of other crops

### **3.5**

#### **moisture content (MC)**

amount of water in the corn on cob or shelled corn expressed in percent (%)

### **3.6**

#### **physiological maturity**

required number of days of the corn to mature (days to maturity) usually characterized by the presence of the black layer at the base of the corn kernel. The black layer indicates that the corn is already mature

**3.7****roguing**

act of removing diseased, damaged, or off-type plants

**4 Recommended practices based on good agricultural practices (GAP) for corn****4.1 Farm production practices**

4.1.1 Observe proper land preparation for healthy and uniform growth of the corn plant as recommended by the PNS for GAP Corn (PNS/BAFS 20:2008) or its latest issuance.

4.1.2 Production areas must be kept clean and tidy at all times. Field sanitation practices must always be maintained. Farm debris as sources of inoculum must be removed to manage population of *A. flavus* or *A. parasiticus*. If possible, a one (1) month to two (2) months fallow period will be observed before planting.

4.1.3 The recommended practices for soil and soil nutrients are in accordance with the PNS for GAP Corn or its latest issuance.

4.1.4 Use varieties or hybrids that are adaptable to the locality and approved by National Seed Industry Council (NSIC) as seed material.

4.1.5 Maintain the recommended row and plant spacing and thin to optimum population density to avoid overcrowding. This can result in reduced yield due to competition for soil nutrients and sunlight. Overcrowding of plants may lead to humid and warm conditions in the canopy which favors insect, microorganism, and disease development. To reduce sources of infection, roguing of diseased plants should be implemented.

4.1.6 Observe the appropriate method and time in applying the recommended combination and amount of fertilizers based on the result of soil analysis. Nutrient deficiencies or over fertilization particularly nitrogen (N) may lead to greater susceptibility to insect pests and diseases.

4.1.7 Seed inoculant may be used to supplement part of the corn plant nutrient requirement.

4.1.8 Apply Integrated Pest Management (IPM) such as using biological control agents and natural enemies of pests and diseases, and the proper use of pesticide only when necessary.

4.1.9 Practice appropriate weed control measures such as proper land preparation, off-barring at 15 to 20 days after planting (DAP), and/or hilling-up at 25 to 30 DAP to minimize weed population. Care should be taken during cultivation to avoid damage to the plant.

4.1.10 Maintain the water requirement to avoid moisture stress particularly during flowering up to the maturation stage. At these stages, the crop is more susceptible to aflatoxin contamination.

4.1.11 If detopping of corn plants is to be practiced, this should be done after physiological maturity has been attained. Early detopping could lead to shriveled and inferior corn grains.

4.1.12 Practice crop rotation to minimize build-up of aflatoxin producing fungi inherent in the soil.

## **4.2 Practices during harvest**

4.2.1 Farm workers involved in harvesting and succeeding operations should wear appropriate clothing and protective gadgets such as long sleeves and dust mask.

4.2.2 Harvest corn at physiological maturity as recommended (approximately 100 to 120 DAP for yellow corn and 90 to 100 DAP for white corn). Harvesting should be completed in the shortest time possible especially during rainy season. Care must be exerted to prevent damage and contamination of corn ears with soil. Use clean mats, screens, and/or other suitable underlays to prevent corn ears from soil or foreign matter contamination.

4.2.3 As much as possible, harvesting should be done on sunny days.

4.2.4 Dehusking is discouraged during rainy season to prevent *A. flavus* infection.

4.2.5 Air-dry immediately the unhusked ears in a well-ventilated area to minimize fungal contamination.

4.2.6 Use clean bags or other suitable containers for the newly harvested corn ears.

4.2.7 Before using machines for harvesting and other post-harvest operations, ensure that all the equipment to be used are functional, clean, and well-maintained to minimize undue damage to the grain.

4.2.8 Sort-out and discard corn ears that show visible signs and symptoms of premature sprouting, insect damage, or microbial infection.

4.2.9 Discarded corn ears should be disposed in a compost pit away from the production area. The recommended depth of the compost pit is one to two (1-2) meters.

## **4.3 Practices after harvest**

### **4.3.1 Hauling and piling**

Haul newly harvested corn ears immediately after harvest. Hauling or transport facilities (e.g. wagons, trucks) to be used for collecting and transporting the harvested corn from the farm to drying facilities or to storage area should be clean, dry, and free from insects and visible microbial growth. For corn ear with husk, the recommended maximum days of piling is three (3) days. Corn ears should be piled with underlay and not directly on the floor. The use of clean matting materials is recommended.

### **4.3.2 Shelling**

4.3.2.1 Before shelling, dry the corn ears to 18-20% MC to minimize grain damage. At this MC, the seed can overcome mechanical damage brought about by the shelling machine.

4.3.2.2 Clean, dry, and properly maintained mechanical sheller should be used to minimize mechanical damage to the kernels and further avoid aflatoxin contamination.

4.3.2.3 Shelled corn should be placed in clean and dry containers. Avoid using containers previously used for fertilizer or chemicals.

4.3.2.4 If immediate shelling is not possible, temporarily store the corn ears in cribs or any structure with good ventilation.

### **4.3.3 Drying**

4.3.3.1 Dry the corn grains to 13 to 14 % MC within 48 hours after shelling. Ensure that corn has been dried uniformly to 13 % or 14 % MC. This can be determined with the use of a calibrated moisture tester. The measurement of the moisture content of the corn should be determined from a representative sample randomly taken from the batch.

4.3.3.2 When using a mechanical dryer, the air-drying temperature should be within 43°C to 50°C. Do not expose corn grains to higher temperature to avoid stress cracks.

4.3.3.3 In case of sun drying, the shelled corn should be protected from direct contact with the soil. Avoid mixing of dry grain with wet grain or any foreign matter.

4.3.3.4 If immediate drying is not possible, temporarily store the corn ears in cribs or other well-ventilated structures to prevent heat build-up and microbial growth.

4.3.3.5 Clean and pest-free suitable containers should be used for the dried corn grains.

### **4.3.4 Transport**

4.3.4.1 The bagged corn grains should be moved to a suitable storage or processing area as soon as possible after drying.

4.3.4.2 To avoid re-wetting of bagged corn grains during transport, appropriate covering for the container should be used. Bagged corn grains to be transported should be properly stacked inside the transport vehicle.

### **4.3.5 Storage**

4.3.5.1 The storage structure should be made of durable materials and should be able to withstand strong winds, rain, and earthquakes. It should be situated in areas where there is no flooding. The design of the warehouse should be able to meet the following minimum requirements, namely:

- a. prevent re-wetting of dry corn grains;
- b. prevent entry of insects, birds, rodents, and other animals; and
- c. provide good ventilation to the stored corn.

4.3.5.2 During storage, follow the first-in first-out (FIFO) principle.

4.3.5.3 The MC of corn should be maintained to not greater than 14 % at all times in storage to prevent the growth of *A. flavus* and/or *A. parasiticus*.

4.3.5.4 Observe proper piling of bagged corn grains inside the warehouse.

4.3.5.5 Maintain cleanliness at all times to prevent pest infestation and aflatoxin contamination.

4.3.5.6 Periodically measure the temperature of the stored corn during storage. A temperature rise may indicate microbial growth and/or pest infestation. In order to avoid fungal invasion and mycotoxin contamination, relative humidity and temperature should be monitored. Warm temperature ranging from 22°C to 44°C, high relative humidity ranging from 85% to 87%, and heavy rain are predisposing factors to fungal invasion and mycotoxin contamination. Visually check corn for evidence of mold growth and separate the infested/ infected portion. Subject infected samples for aflatoxin analysis if possible.

4.3.5.7 If the corn stocks will be stored for more than a month, pest control administration should be in accordance with PNS Good Warehousing Practices for Bagged Grains (PNS/BAFS 193:2017).

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