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Outline 大綱

1. Corn grading & Inspection 玉米分級與檢視
2. Mycotoxins: Challenges, prevention and treatment 黴菌毒素的挑戰,預防及處理 &
3. Corn 2011: Production forecast 2011年玉米產量預測

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Corn grading 玉米分級

- Corn is divided into three classes based on color: 依顏色分三類
 - Yellow corn 黃玉米
 - White corn & 白玉米
 - Mixed corn 混合玉米
- Each class is divided into five U.S. numerical grades and U.S. Sample Grade 每類又分為美國5數字級與美國樣品級
 - White corn is considered a food grade corn 白玉米為食用級玉米
 - Yellow corn is primarily used for animal feed 黃玉米主為飼料用
 - Special grades are provided to emphasize special qualities or conditions affecting the value. They do not affect the numerical or sample grade designation 特定級強調特定品質或價值,不影響其數字或樣品分級

Examples: Flint, Flint and Dent, Infested and Waxy 如硬,硬與凹,受損與蠟玉米

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Corn grades and grades requirements 玉米分級與分級要求

Grade	Maximum Limits of -		Maximum Limits of -	
	Test weight per bushel (pounds)	Heat-Damaged kernels (percent)	Damaged kernels total (percent)	Broken Corn and Foreign material (percent)
U.S. No. 1	56.0	3.1	3.0	2.0
U.S. No. 2	54.0	3.2	3.0	3.0
U.S. No. 3	52.0	3.3	7.0	4.0
U.S. No. 4	49.0	1.0	10.0	3.0
U.S. No. 5	46.0	3.0	15.0	7.0

Corn grading examples 玉米分級範例

- U.S. No. 2 White Corn, Infested 美國2級白玉米,受損
- U.S. Sample Grade Yellow Corn, Infested 美國樣品級黃玉米,受損

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U.S. Sample Grade is Corn that... 美國樣品級玉米是

- Does not meet the requirements for grades U.S. No. 1, 2, 3, 4, or 5; or 不符合美國5數字及或
- Contains stones (in excess of 0.1 percent of the sample weight), 2 or more pieces of glass, 3 or more crotalaria seeds (*Crotalaria* spp.), 2 or more castor beans (*Ricinus communis* L.), 4 or more particles of an unknown foreign substance(s) or a commonly recognized harmful or toxic substance(s), 8 or more cocklebur (*Xanthium* spp.) or similar seeds singly or in combination, or animal filth in excess of 0.20 percent in 1,000 grams; or 每千克含>0.1%石頭,或2片以上玻璃,或3個以上種子或,或4個以上不明物或有害物,或8個以上草種子及動物糞便超過0.2%
- Has a musty, sour, or commercially objectionable odor; or 發霉,發酸不良氣味
- Is heating or otherwise of distinctly low quality 發熱或明顯低品質

Corn grading steps 玉米分級步驟

Step 1: Examine the sample for heating, odor, animal filth, castor beans, crotalaria seeds, glass, insect infestation, stones, unknown foreign substances and other unusual conditions 檢視樣品發熱,氣味,動物便,蓖麻子,草種子,玻璃,蟲害,石頭,不明物及其他不正常情形

Step 2: Determine the moisture content 測水分含量

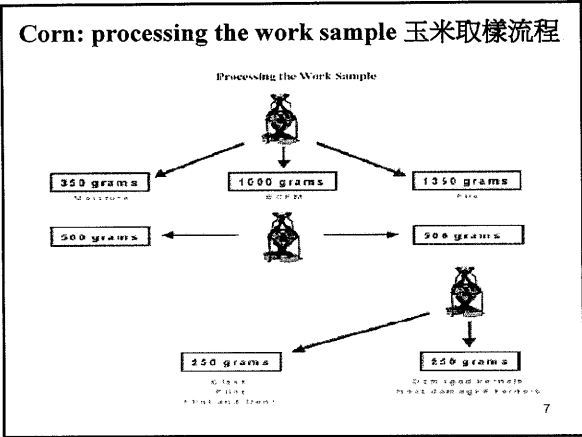
Step 3: Determine the test weight per bushel of the sample 測每蒲耳重

Step 4: Determine the percentage of Broken Corn and Foreign Material (BCFM) in the sample 測破碎玉米及異物比例(BCFM)

Step 5: Divide out representative from the BCFM-free sample and determine the percentage of class, damaged kernels, flint corn, flint and dent corn, heat-damaged kernels, and waxy corn. 取無破碎及異物之樣品測含玻璃,破碎核,硬玉米,硬與凹玉米,熱破壞核,及蠟玉米比例

Step 6: On request: divide out a representative portion from the BCFM-free sample and determine the percentage of protein, oil and /or starch. 取無破碎及異物之樣品測蛋白質,脂肪及/或澱粉

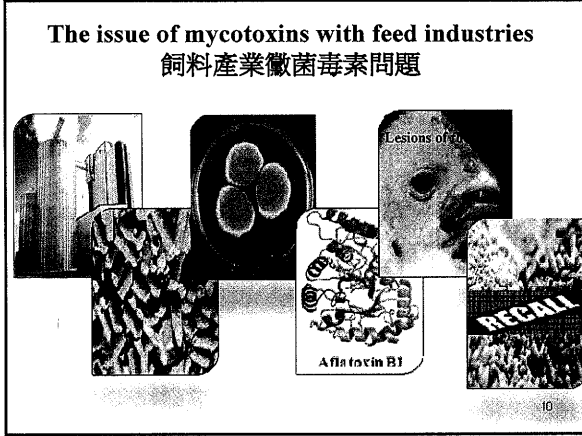
Step 7: On request: analyze 10 pounds of representative sample for aflatoxin (ppb) or 250 grams for vomitoxin (ppm) or zearlenone (ppm). 測10磅樣品所含黃麴毒素或250克樣品所含嘔吐毒素或玉米烯酮



Who can determine corn quality 誰能決定玉米品質

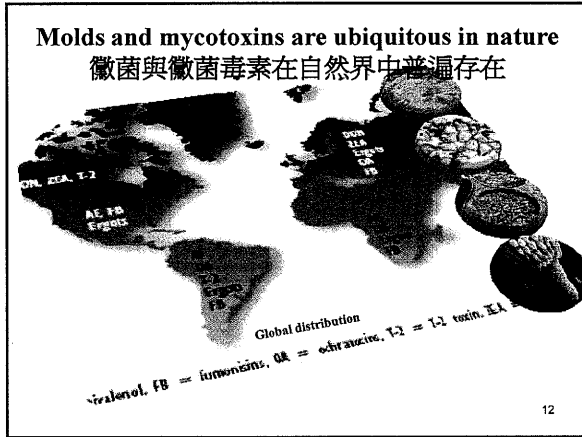
- ❑ Grain grader licensed under the United States Grain Standards Act or the United States Warehouse Act (USWA) 依美國穀物標準法規或美國倉管法規認證的穀物分級員
- ❑ Grain grader licensed under State law and employed by a warehouse operator who has a storage agreement with the Commodity Credit Corporation (CCC) 依州法律認證的穀物分級員及商品認證協會認可受雇的倉儲操作員

Molds and Mycotoxins 黴菌與黴菌毒素



Mycotoxins 黴菌毒素

- ❑ World population growth demanding more meat means more grain and feed 全球人口成長提高肉、穀物、飼料需求
- ❑ Federal agencies and global customers demanding safe and better quality feed products 政府機構及全球客戶要求安全與高飼料品質
- ❑ Mycotoxins are a severe problem in the animal feed industry 黴菌毒素是動物飼料產業的大問題
- ❑ Raw-ingredients (cereal grains) are the #1 source of contamination 生原料(穀物)是第一的污染源
- ❑ Other major source of contaminants are air and insects 其他污染源是空氣及昆蟲
- ❑ Poor sanitary condition in feed mills may favor mold growth 不潔的飼料廠加速黴菌生長
- ❑ Storage conditions of raw-ingredients and finished feed products may favor mold growth and subsequent mycotoxin synthesis 原料及飼料儲存條件也會促進黴菌生長及黴菌毒素合成



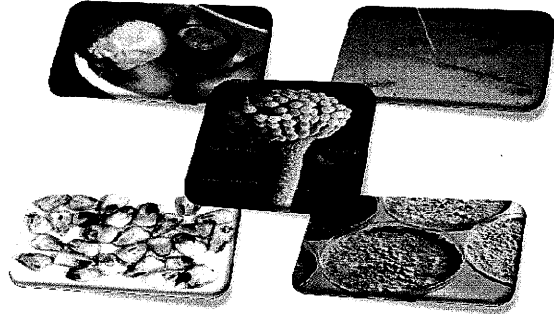
Why are molds and mycotoxins important?
為什麼黴菌與黴菌毒素很重要

- ❑ Molds are important as spoilage organisms 黴菌是重要發霉生物
- ❑ Cause diseases in humans, livestock animals, crops, fruits and vegetables 造成人,家畜,穀物,水果及蔬菜疾病
- ❑ Molds spoil grain, feed & food products 黴菌破壞穀物,穀物及食物產品
- ❑ Molds can produce mycotoxins 黴菌產生黴菌毒素



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What does mold look like?
黴菌長什麼樣子



<http://www.inspectormedia.com/images/mold02020001.jpg>
http://www2.abe.com.au/Abel/516/ContentArea/foodspoil_mould.jpg
<http://www.fishbase.org/mold/image/518.jpg>

The life cycle of fungi 黴菌生活史

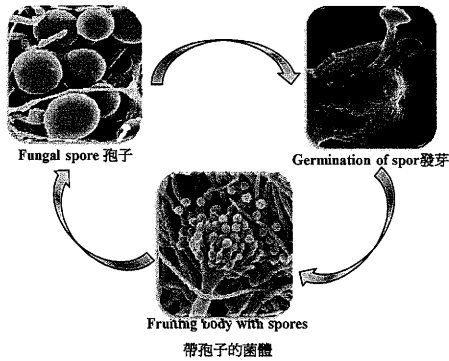


Image source: <http://www.vinadourlimited.com>

Importance of mycotoxins
黴菌毒素的重要性



- ❑ Most molds do not produce mycotoxins 多數黴菌不產生毒素
- ❑ Over 400 identified mycotoxins 已知超過400種毒素
- ❑ 30 well-characterized mycotoxins are considered harmful to animals and humans 30種確知毒素對動物及人有害
- ❑ Usually ingested in contaminated food 常吃到污染的食物
- ❑ Most of these are not destroyed in normal cooking conditions 多數無法以一般加熱破壞
- ❑ Usually no treatment for mycotoxin poisoning (mycotoxicosis) 一般無法處理毒素中毒

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Mycotoxins: Important facts
黴菌毒素的重要事實



- ❑ Mycotoxins are not visible to the eye 眼睛看不到
- ❑ Not all moldy grains/feed/foods contain mycotoxins 不是所有含黴菌的穀物/食物都有毒素
- ❑ Grain/feed/food does not have to look moldy to be contaminated 穀物/食物不一定發霉才含毒素
- ❑ Not all grains/foods containing mycotoxins are 'toxic' 非所含毒素都是毒
- ❑ Mycotoxins may not be uniformly distributed 毒素非均一分布
- ❑ Molds grow over a temperature range of 10 to 40 °C (50 to 104 °F), a pH range of 4 to 8, and above 0.7a_w (water activity) 黴菌生長溫度在10-40°C (50-104°F), pH 4-8及超過0.7a_w(水活力的)環境

Importance of mycotoxins 黴菌毒素的重要性

- ❑ Mycotoxins are secondary metabolites produced by molds that are capable of causing disease and death in humans and other livestock animals 黴菌毒素是黴菌的二次代謝物,能造成人與家畜生病及死亡
- ❑ In 1960 approximately 100,000 turkeys died as a result of eating aflatoxin contaminated peanut 1960年約10萬隻火雞因黃麴毒素污染的花生而死亡
- ❑ Worldwide, approximately 25% of crops are affected by mycotoxins with loss of billions of dollars annually 全球約25%穀物受毒素影響,每年損失數十億元
- ❑ Annual economic costs of mycotoxins to the U.S. agricultural economy is estimated to average \$1.4 billion 因毒素造成美國農業經濟損失約14億
- ❑ Economically important mycotoxins: aflatoxins, fumonisins, deoxynivalenol, ochratoxin A, zearalenone 主要毒素: 黃麴毒素、伏馬镰孢毒素、嘔吐毒素、赭麴毒素

<http://www.cee.ncsu.edu/laester/drough/Mycotoxin-Review.pdf>

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Important mold species and mycotoxins 重要黴菌種類及黴菌毒素

- ❑ **Aflatoxins B1, B2, G1, G2 and cyclopiazonic acid 黃麴毒素及cyclopiazonic acid**
Aspergillus falvus (B1 & B2), *A. parasiticus* (B1, G1 & G2)
- ❑ **Trichothecenes: Group A (T-2 toxin, HT-2 toxin) and Group B (DON, Nivalenol) 新月毒素分A與B群**
Fusarium/Stachybotrys spp. and many others
- ❑ **Ochratoxin A 赭麴毒素**
A. ochraceus, *A. carbonarius* and *P. verrucosum*
- ❑ **Fumonisin 伏瑪鐮孢毒素**
Fusarium verticillioides.
- ❑ **Zearalenone 玉米烯酮**
Fusarium spp. and others

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FDA action levels for Aflatoxin FDA黃麴毒素行動標準

Corn; oilseeds; spices; nuts 玉米,油籽類,香料類,果仁類

- ❑ **20 ppb**
corn, peanut products, cottonseed meal, other animal feeds and feed ingredients 玉米,花生產品,棉籽粕,其他動物飼料及原料
dairy animals and when intended use unknown 動物乳製品及用途不明
- ❑ **20 ppb**
corn, peanut products, other animal feeds and feed ingredients; excluding cottonseed meal 玉米,花生產品,其他動物飼料及原料;不含棉籽粕.
immature animals 未成熟的動物
- ❑ **100 ppb**
corn, peanut products 玉米,花生產品
breeding beef cattle, breeding swine, mature poultry (e.g., laying hens) 種肉牛,種豬,成熟雞(如蛋雞)

Must be reported to FDA and lots are subject to FDA seizure
必須向FDA報告並沒收

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FDA action levels for Aflatoxin FDA黃麴毒素行動標準

- ❑ **200 ppb**
corn, peanut products 玉米,花生產品
finishing swine (>100 lb) 超過100磅的肥育豬
- ❑ **300 ppb**
cottonseed meal 棉籽粕
beef cattle, swine or poultry (any age and breeding status) 肉牛,豬或雞(任何日齡及育種階段)
- ❑ **300 ppb**
corn, peanut products 玉米,花生產品
finishing beef cattle (e.g., feedlot cattle) 肥育肉牛(如圈飼肉牛)

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FDA advisory levels for Deoxynivalenol (Vomitoxin) FDA嘔吐毒素建議標準

- ❑ **5 ppm**
grain and grain byproducts for swine 豬用穀物及副產品
not more than 20% of ration 不能超過飼料20%
- ❑ **10 ppm**
grain and grain byproducts for cattle and chicken 牛雞用穀物及副產品
not more than 50% of ration 不能超過飼料50%
- ❑ **5 ppm**
grain and grain byproducts for all other animal species 其他動物用穀物及副產品
not more than 40% of ration 不能超過飼料40%

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FDA guidance for Fumonisin (FB₁+FB₂+FB₃) – Human Food FDA伏瑪鐮孢毒素指導標準-食品

Mostly in corn (maize) 主要在玉米

- ❑ **2 ppm**
degermed dry milled corn products 去胚乾粉碎玉米產品
- ❑ **3 ppm**
cleaned popcorn 乾淨的爆米花玉米
- ❑ **4 ppm**
cleaned corn for masa 乾淨的玉米
whole or partially degermed dry milled corn products 完整或部分去胚乾粉碎玉米產品
dry milled corn bran 乾粉玉米麩皮

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FDA guidance for Fumonisin (FB₁+FB₂+FB₃) – Animal Feed FDA伏瑪鐮孢毒素指導標準-動物飼料

Mostly in corn (maize) 主要在玉米

- ❑ **5 ppm**
equids, rabbits ?, 兔子
not more than 20% of diet 不能超過飼料20%
- ❑ **20 ppm**
swine, catfish 豬,鯰魚
not more than 50% of diet 不能超過飼料50%
- ❑ **30 ppm**
breeding ruminants, lactating dairy cattle, breeding poultry, breeding minks 種用反芻動物,泌乳牛,種雞,種貂
not more than 50% of diet 不能超過飼料50%

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FDA guidance for Fumonisin (FB₁+FB₂+FB₃) – Animal Feed FDA伏馬鐮孢毒素指導標準-動物飼料


Mostly in corn (maize) 主要在玉米

- ❑ 60 ppm
ruminants raised for slaughter, mink for pelts 屠宰用反芻類, 皮毛用貂
not more than 50% of diet 不能超過飼料50%
- ❑ 100 ppm
poultry raised for slaughter 屠宰用雞
not more than 50% of diet 不能超過飼料50%
- ❑ 10 ppm
all other species or classes of livestock and pet animals 其他家畜及寵物
not more than 50% of diet 不能超過飼料50%


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Mycotoxins in corn 玉米黴菌毒素

- ❑ The most commonly found mycotoxins in the US corn are aflatoxin, fumonisin, and deoxynivalenol (DON) 美國玉米常見黴菌毒素為黃麴毒素, 伏馬鐮孢毒素, 嘔吐毒素
- ❑ The detection of aflatoxin in corn can result in a reduced price for grain or even rejection 玉米黃麴毒素檢測結果可能導致降價或退貨



Aspergillus flavus on corn



Fusarium moniliforme causing "starburst" in corn

Source: <http://www.ces.ncsu.edu/depts/pp/notes/Corn/corn001.htm#table>

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Ochratoxin A and zearalenone 赭麴毒素與玉米烯酮

- ❑ No action, guidance or advisory levels for ochratoxin A or zearalenone have been established by the FDA in animal feeds
FDA無動物飼料赭麴毒素或玉米烯酮行動, 指導或建議標準
- ❑ These two mycotoxins are handled on a case-by-case basis
此二毒素依個案處理

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Mycotoxins in feed products: Challenges 飼料黴菌毒素的挑戰

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Risks of mycotoxin contaminated feed 黴菌毒素污染飼料的風險


- ❑ **Farmers and grain elevators 農民與穀倉**
 - ❑ Loss in yield due to mold infection in field, and during storage 因農地黴菌感染造成產量及儲存損失
 - ❑ Low price for the product 產品價格降低
 - ❑ Management of moldy and mycotoxin contaminated grain 管理發霉及黴菌毒素污染穀物
 - ❑ Export (EU has strictest mycotoxin standards in the world) 出口(歐盟標準全球最嚴)
- ❑ **Feed Industry: 飼料產業**
 - ❑ Direct loss of feed products/ production loss 飼料產品及生產直接損失
 - ❑ Recalls 回收
 - ❑ Loosing market 失去市場
 - ❑ Export (EU has strictest mycotoxin standards in the world) 出口
- ❑ **Livestock Industry 家畜產業**
 - ❑ Feed refusal/ reduced feed intake/ weight loss 拒食, 降低採食量, 失重
 - ❑ Affects the total nutrition intake and low performance 影響整體營養分攝取及降低表現
 - ❑ Reproductive effects - abortion, reduced lactation etc. 繁殖問題-流產, 泌乳降低等
 - ❑ Mortality 死亡
- ❑ **For consumers 消費者**
 - ❑ Vomiting, 嘔吐
 - ❑ Fever-Jaundice 發燒, 黃疸
 - ❑ Cancer and 癌症
 - ❑ Death 死亡

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Soybean meal in animal feed 飼料中黃豆粉

- ❑ Soybean meal (SBM) is one of the major protein of choices for feed manufacturers
黃豆粉是飼料業者主要蛋白質選擇
 - ❑ High in crude protein (~50%) content 高粗蛋白質含量
 - ❑ Year round availability 全年都有
- ❑ In the US it contributes to about \$15 billion annually 在美國價值約150億
- ❑ Soybeans are grown on >73 million acres with an average of 40 bushels per acre and a total production of ~3 billion bushels 黃豆種植超過7300萬英畝, 平均每畝生產40蒲耳, 共30億蒲耳
- ❑ Mycotoxin contamination of soybeans is *not considered a significant problem* as compared to commodities such as corn, cottonseed, peanuts, barley and other grains 黃豆黴菌毒素的問題較玉米, 棉籽粕, 花生, 大麥及其他穀物不嚴重
- ❑ Common contaminants are T-toxins, DON, zearalenone by *Fusarium* spp. during storage 一般污染為伏馬鐮孢菌在儲存間生成的T毒素, 嘔吐毒素, 玉米烯酮

Distribution of soybean meal usage



- Beef
- Dairy
- Poultry
- Fish and seafood
- Other

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Corn in animal feed 飼料中玉米

- ❑ Corn (bran, germ, DG) is one of the predominant source of ingredient in feed products (~50% of US production, ~6 billion bushels) 玉米(麩皮,胚,穀物酒糟)是最主要的飼料原料之一(約50%的美國玉米,60億蒲耳)
- ❑ Corn is often contaminated with mycotoxins 玉米經常受黴菌毒素汙染
- ❑ High corn price may lead to use of poor quality corn for ethanol conversion 高玉米價格可能導致應用低品質玉米生產乙醇
- ❑ Corn-based ethanol byproduct: DDGS 玉米乙醇副產品:玉米酒糟
- ❑ 90% of distillers grains (DG) are used for domestic animal feed (FDA 2006) 90%的穀物酒糟作為動物飼料
- ❑ Mycotoxins concentrates up to 3X in DG 穀物酒糟的黴菌毒素含量提高為三倍
- ❑ DG is directly sold to livestock producers and feed manufacturing facilities 穀物酒糟直接售給家畜生產業者及飼料廠
- ❑ Concern of mycotoxins (aflatoxins, fumonisins, deoxynivalenol, ochratoxin A, zearalenone) directly entering the feed chain 在意的毒素直接進入飼料鏈中

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Wheat in animal feed 飼料中的小麥

- ❑ Wheat middlings (endosperm, bran, germ) and wheat red-dog are an important source of energy, protein, vitamins and minerals. 粉頭(胚乳,麩皮,胚芽)與紅小麥是重要的能量,蛋白質,維生素及礦物質來源
- ❑ *Fusarium* Head Blight causes vomitoxin in wheat: Wet weather occurs during the flowering and grain filling stages of wheat crop development 伏馬鏽菌生成小麥的嘔吐毒素: 開花結實時潮濕的氣候造成
- ❑ Wheat by-products are used extensively in feeds for a variety of species 小麥副產品廣泛用於各種飼料中
- ❑ Concern with direct addition of DON/vomitoxin to animal feed 在意的嘔吐毒素直接加到飼料中

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Cottonseed in animal feed 飼料中的棉籽粕

- ❑ Cottonseed meal is one of the important sources of protein used to balance livestock diet 棉籽粕是平衡飼料蛋白質的主要來源
- ❑ Often contaminated by aflatoxins 常被黃麴毒素汙染

Sorghum by-product in animal feed 飼料中的高粱副產品

- ❑ Milo hominy, or grain sorghum mill feed, is a mixture of grain sorghum bran and germ, and part of the starchy portion of grain sorghum kernels 碎高粱或高粱粉為高粱麩皮,胚芽及部分高粱核之混合物
- ❑ Concern with direct addition of aflatoxin and zearalenone to animal feed products 在意的黃麴毒素和玉米烯酮直接加到飼料中

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Mycotoxins and toxin levels 黴菌毒素與毒素量

Fungus	Toxins	No clinical effect	Toxic level	Clinical signs
<i>Aspergillus</i> sp.	Aflatoxins	< 100ppb	500 - 2000ppb	Poor growth Liver damage Jaundice Immune suppression
<i>Aspergillus</i> sp. and <i>Penicillium</i> sp.	Ochratoxin & Citrinin	< 100ppb	200 - 4000ppb	Reduced growth Frost Kidney damage
<i>Fusarium</i> sp.	F2 DAS DON [Vomitoxin] Zearalenone F2 toxin	< 2ppm	4 - 20ppm	Reduced feed intake Immuno-suppression Vomiting
<i>Fusarium</i> sp.		< 3.05ppm	1 - 30ppm	Infertility Abortus Rectal prolapse Pseudo pregnancy Delayed repeat matings
<i>Fusarium</i> sp.		< 50ppm		Early embryo mortality
<i>Fusarium</i> sp.	Fumonisins	< 10ppm	20 - 175	Reduced feed intake Fungus in lungs Respiratory symptoms Absortion
Ergot	Ergotoxin	< 0.05%	0.1-1.0%	Reduced feed intake Ergot bodies by weight Gangrene of the extremities Agalactia due to mammary gland failure.

ppm - parts per million ppb - parts per billion
sp - species - each of these fungi have several species only some of which are toxic.
(Fig. 13-4)

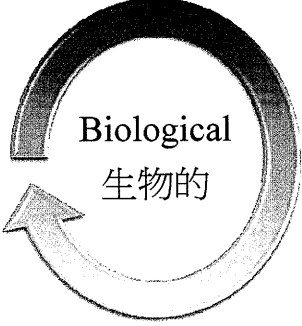
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Mycotoxins in feed products: How to prevent ? 飼料黴菌毒素的預防

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Factors favoring mold incidence 有利黴菌發生的因素

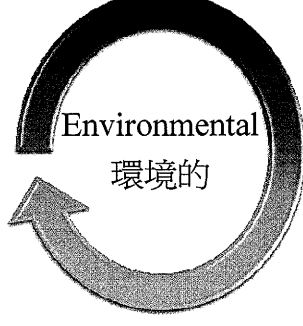
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Biological
生物的

- ❑ Hybrids (Bt. corn)
雜交玉米
- ❑ Plant maturity
植物成熟
- ❑ Soil moisture
土壤濕度

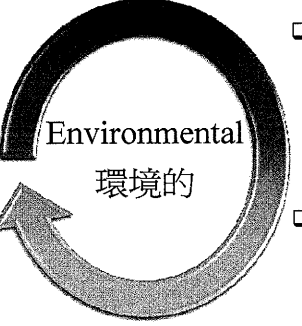
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Environmental
環境的

- ❑ Temperature溫度
- ❑ Relative humidity
相對濕度
- ❑ Soil moisture土壤
濕度
- ❑ Nutrients養分
- ❑ Bird damage鳥害
- ❑ Insect damage蟲害
- ❑ Irrigation灌溉
- ❑ Rain雨水

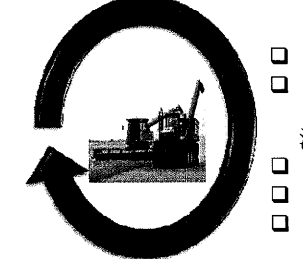
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Environmental
環境的

- ❑ Cool, wet weather冷溼
氣候
Fusarium spp.
 - DON/Vomitoxin
 - T-2 toxin (T-2)
 - Zearalenone (F-2)
 - Fumonisin
- ❑ Hot, humid weather熱
濕氣候
Aspergillus spp.
 - Aflatoxin

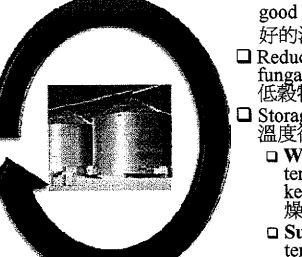
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Harvesting收穫

- ❑ Grain moisture穀物水分
- ❑ Service equipment &
clean equipment處理與清
潔設備
- ❑ Drying乾燥
- ❑ Bin cleaning穀倉清潔
- ❑ Residual grain殘留穀物

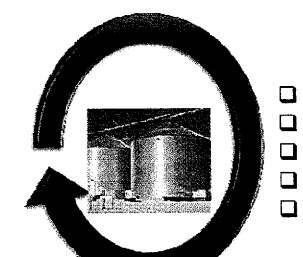
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**Preparing for
storage**儲存準備

- ❑ Field damaged grain, regardless of
reason, should not be mixed with
good grain農地上不好的穀物不要和
好的混合
- ❑ Reduce grain moisture - it arrests
fungal development and mycotoxin降
低穀物濕度能限制黴菌生長與毒素
- ❑ Storage temperatures are critical儲存
溫度很重要
 - ❑ Winter months (冬): after drying,
temperatures between 34 and 40°F
keeps fungal metabolism reduced乾
燥後溫度應在34-40F
 - ❑ Summer months (夏): grain
temperature between 55 and 65°F
acceptable保持在50-60F
- ❑ Maintain 1-2% lower moisture for
field damaged grain (Ex: 13-14% corn
instead of typical 15%)農地上受損穀
物應降1-2%水分

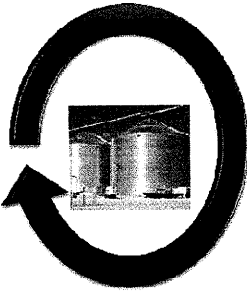
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Storage儲存

- ❑ Temperature溫度
- ❑ Relative humidity相對濕度
- ❑ Grain moisture穀物水分
- ❑ Oxygen氧氣
- ❑ Insect infestation蟲害困擾

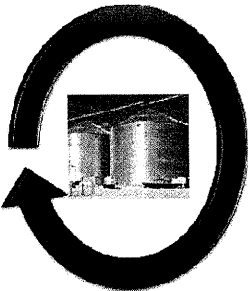
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Storage 儲存

- ❑ Storage molds grow at moistures of 13- 20% or moistures in equilibrium with 65-90% RH 儲存黴菌在水分13-20%及相對溼度65-90%生長
- ❑ Members of the genera *Aspergillus* and *Penicillium* 麴菌屬及青霉菌屬

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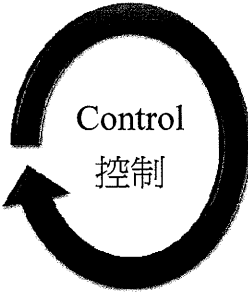
Storage 儲存

- ❑ Check grain twice a week 每週檢查穀物2次
- ❑ Look for crusted, colored, wet, slimy grain on top surface 檢查表層破損殼、變色、濕度、汙穢穀物
- ❑ Poor flow out of grain bins 穀物流動(差)
- ❑ A musty or moldy odor indicates the beginning of the storage problem (fermented smell = serious problem) 霉味表示發霉問題
- ❑ Watch temperature: If temperature of the grain begins to raise (hotspot), the aeration fans should be turned on immediately 注意氣候溫度(升溫要開通風)

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Mycotoxins in feed products: Control
飼料黴菌毒素的控制

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Control
控制

- ❑ Physical 物理性
- ❑ Biological & 生物性
- ❑ Chemical 化學性

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Physical Methods 物理方法

- ❑ **Cleaning/separation 清理/分離**
 - ❑ Effective removal of fines (aflatoxins), broken kernels, chaffy seeds reduces (BKCS) the mycotoxin content in the stored grain 有效去除細粉,破核,空殼能降低儲存穀物的黴菌毒素量
- ❑ **Heating/irradiation (ex: peanuts) 加熱/輻射(如花生)**
 - ❑ Reduces 40-60% of the toxins 減少40-60%毒素
- ❑ **UV irradiation UV照射**
 - ❑ Exposure of toxin contaminated milk with UV light reduced AFM1 up to 100% depending on the exposure time 依暴露時間,UV可減少毒素汙染牛奶黃麴毒素量達100%
 - ❑ Toxicity in peanut was reduced by 75 to 100% after exposing it to gamma irradiation at dosages of 1 to 10 kg respectively 花生經γ照射後可減少75-100%毒素
- ❑ **Roasting 烘培**
 - ❑ Roasting may reduce mycotoxin contamination by burning surface contaminants and removing volatile, heat labile toxins and other mold metabolites 烘培可去除表面易受熱影響毒素及代謝物等毒素
 - ❑ Roasting coffee beans at 200°C for 5 minutes reduces the ochratoxin A by 78.6% 烘培咖啡200C 5分鐘能減少赭毒78.6%

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Extrusion 擠壓

- ❑ Extruding contaminated cottonseed at 160°C as compared to 104 °C reduced 33% of aflatoxins in the feed product 與104C比較,160C擠壓受汙染棉籽粕能減少飼料黃麴毒素33%
- ❑ Multi-pass-extrusion (four times than once) reduced another 55% of aflatoxins in the feed product 多次擠壓(4次而非1次)能進一步減少飼料55%黃麴毒素
- ❑ Extrusion with 0.3% lime and 1.5% hydrogen peroxide was the most effective process in reducing aflatoxins in corn tortillas 以0.3%石灰及1.5%過氧化氫擠壓能有效降低玉米餅黃麴毒素
- ❑ However, high lime and hydrogen peroxide affected the taste and aroma of final tortillas 但高量石灰與過氧化氫會影響口感及風味
- ❑ Extrusion was also found effective against DON/vomitoxin 烘培對嘔吐毒素也有效

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Biological Methods 生物方法

- **Microbial degradation: 微生物分解**
 - De-epoxidases enzyme (from the genus Eubacteria) can be used in degradation of tricothecenes 去epoxidases酵素可分解新月毒素
 - Yeast strain (*Trichosporon mycotoxinivorans*) is capable of degrading ochratoxin A 酵母菌屬能分解赭毒素
- **Bt. Corn Bt 雜交玉米**
 - Bt. corn reduces the insect damage (thus reducing plant stress and exposure to mold spore) Bt雜交玉米能減少蟲害(降低植物受黴菌孢子的影響與暴露)
 - It is estimated that a total benefit of Bt corn's reduction of fumonisin and aflatoxin in the US is around \$23 million/yr 每年降低伏馬鐮孢毒素及黃麴毒素的損失達2300萬元
- **Non-toxic strains: 無毒黴菌**
 - competition with toxic strains of *Aspergillus* spp. 與產毒黴菌競爭
- **Bacterial strains: 細菌菌屬**
 - Several bacterial species, such as *Bacillus*, *Lactobacilli*, *Pseudomonas*, *Ralstonia* and *Burkholderia* spp., have shown the ability to inhibit *Aspergillus* spp growth and subsequent aflatoxin synthesis 數個細菌屬如桿菌, 乳酸菌等能抑制黑麴菌生長與黃麴毒素合成

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Chemical Methods 化學方法

Ammoniation (ammonia) 氨氣法

- Effective against aflatoxin and fumonisin contaminated corn and cotton seed 有效對付黃麴毒素與伏馬鐮孢毒素污染的玉米和棉籽粕
- Ammoniation reduced aflatoxins in the range of 30-45% 氨氣處理能減少30-45%的黃麴毒素
- Effective against aflatoxin contaminated feed 有效處理黃麴毒素污染的飼料
- Approved in several countries 多國認可此處理方法
- Less effective against other mycotoxins 對其他毒素效果差
- Found effective in reducing aflatoxins in rice (up to 90-100%) 對降低稻米黃麴毒素有效(達90-100%)
- May end up as a residue in feed causing deterioration of animal health performance 可能殘留在飼料中而對動物健康有害

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Chlorine Dioxide 二氧化氯

- ClO₂ gas was effective in reducing tricothecene (verrucarin and roridin) on paper, glass and cloth @1000ppm with long exposure times 長時間以1000 ppm 二氧化氯氣體處理能減少紙, 玻璃及衣服的新月毒素
- Variation in the data with ClO₂ treatment 處理結果差異大

Ozone 臭氧

- Ozone treatment resulted in reduced sporulation, hyphal growth and mycotoxin synthesis 臭氧處理能降低孢子形成, 菌絲生長及黴菌毒素合成

Citric acid 檸檬酸

- Use of 1 N aqueous citric acid reduced aflatoxins in corn by 96% to 100% 以1 N檸檬酸處理能降低玉米黃麴毒素96-100%

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Practical applicability of detoxification methods

去毒方法的應用

- Efficacy depends on type and distribution of mycotoxin throughout the lot 效果視所感染的毒素種類及分布而定
- Often results in high product loss 經常導致產品損失
- Expensive 昂貴
- Time consuming 費時
- Availability of technology 技術的取得
- May destroy the nutrients in feed products 可能破壞飼料營養
- May not be legal 可能不合法規

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Binders 吸附劑

Chemicals that binds to mycotoxins through binding site and avoid toxins to react with GIT or animal body and are usually excreted

此化學物具結合點吸附黴菌毒素後排出, 以降低毒素對腸道或動物體的影響

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Ideal binder qualities 理想的吸附劑

- Reduces mycotoxin activity 能降低黴菌毒素作用
- Effective adsorption of mycotoxins from GIT of livestock animals 能有效吸附腸道黴菌毒素
- Reduce residues 減少殘留
- Will not affect the animal 不影響動物
- Resistant to feed processing 不受飼料加工影響
- Economic 具經濟價值
- Easily available in the market 容易自市場取得

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Types of Binders 吸附劑種類

- ❑ Organic products 有機產品
 - ❑ Diocatin A, aflastatin A, dillapiol, indigestible carbohydrates (cellulose, glucomannans, peptidoglycans), etc.
 - ❑ Diocatin A, Dillapiol, aflastatin-A, and Apiol as specific inhibitors of biosynthesis of aflatoxin G1 in Aspergillus parasitics 能抑制黃麴毒素合成
- ❑ Inorganic products 無機產品
 - ❑ Activated carbon, aluminosilicates (clay, bentonite, montmorillonite, seolite, phyllosilicate etc.), Polyvinylpyrrolidone (PVP), montmorillonite, bentonite etc. 活性碳,水和矽酸鋁等
- ❑ Hydrated sodium calcium aluminosilicate (HSCAS) 水和矽酸鋁
 - ❑ Mostly studied one, "aflatoxin-selective clay" 多數研究是對黃麴毒素具選擇性的粘土

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Binders 吸附劑

- ❑ Binders can provide solution to manage mycotoxins in animal feed 吸附劑能協助飼料黴菌毒素管理
- ❑ However, results vary with type of mycotoxins, their amounts, animal species and feed type 結果依黴菌毒素種類,含量,動物及飼料而異
- ❑ Currently no product meets all the characteristics for a desirable binder 目前無完全符合理想的吸附劑
- ❑ No binder-products are approved by the FDA for such claims 就功能而言,沒有一項產品是FDA許可
- ❑ Most of the binders are generally regarded as safe (GRAS) to use in the feed 多數產品一般認定在動物使用是安全的
- ❑ The use of sodium aluminosilicate and hydrated sodium calcium aluminosilicate (HSCAS) as binders for mycotoxins is not considered to be generally recognized as safe (GRAS) according to FDA's Center for Veterinary Medicine (CVM) FDA獸醫醫學中心不認為水和矽酸鋁的應用是安全的
- ❑ Furthermore, any mycotoxins which are bound might not remain bound when the feed is consumed and exposed to the acid environment of the gut 此外,在腸道酸性環境中,結合的黴菌毒素可能不在結合

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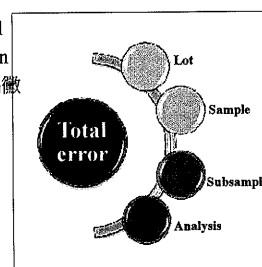
Blending 混合

- ❑ Deliberate mixing of adulterated food with good food renders the finished product adulterated under FDA act 混合摻雜食物FDA法規
- (Sec. 555.200 Adulterated food mixed with good food)
- ❑ Blending mycotoxin contaminated grain is generally not permitted 一般不同意混合受污染的穀物
- ❑ States may have to request for a special permission explaining extraordinary situations 特殊情況下,州政府要求先取得特定許可
- ❑ Blending, toxin content in the final product, shipping information and final usage should be recorded strictly 混合含毒素之最終產品運送及使用資料須嚴格記錄
- ❑ To date, blending of corn with > 500 ppb total aflatoxins has not been permitted 至今,不允許混合超過500 ppb黃麴毒素的玉米

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Sampling and sampling errors during mycotoxin analysis 黴菌毒素採樣及錯誤

- ❑ Sampling is one of the most critical factor in determining the mycotoxin content in the product 採樣是產品黴菌毒素分析最重要變因
- ❑ For a representative average of contaminated product the sample sizes should be as large as possible 污染產品採樣要越大(多)越好



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When to test for molds/mycotoxins 何時測黴菌/黴菌毒素

- ❑ All other possible causes of symptoms rejected 所有可能原因都排除
- ❑ Symptoms for moldy feeds/fermentation smell 有發霉/發酵味道
- ❑ Significant changes in production and health 生產與健康顯著改變
- ❑ Similar symptoms in large number of animals 大量動物有類似問題

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Types of tests for mycotoxins 黴菌毒素檢測種類

- ❑ Quick Test (Qualitative/Quantitative) 快速(定性/定量)
 - ❑ Immunochromatographic strip
 - ❑ Thin Layer Chromatography (TLC)
 - ❑ Immunoassays (ELISA)
 Use: *Detects Specific Mycotoxin* 決定毒素種類及檢測極限
Limited range
- ❑ Confirmatory Tests (Quantitative) 確認分析(定量)
 - ❑ High Pressure Liquid Chromatography(HPLC)
(Requires well trained technicians and equipment)
 Use: *Determines level of mycotoxins* 決定毒素含量及多種檢測
Detect several mycotoxins

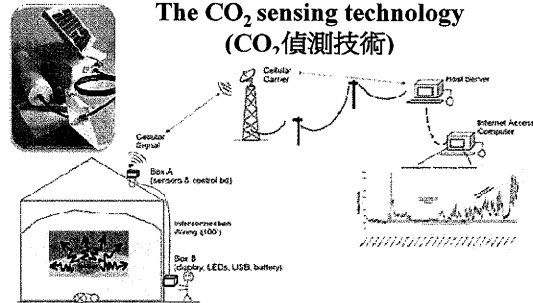
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Monitoring stored grain quality 監控儲存之穀物品質

- Traditional methods for spoilage detection in bins involves manual walking, smelling, and sampling the grain inside the storage structure and temperature monitoring 傳統以人力檢查儲存情形、溫度及穀倉發霉情形
- Human sensory exposure for mold spoilage and other quality parameters is biased and it varies from person-to-person 人力檢查有個人差異
- Unfortunately, a temperature cable will not detect the mold growth several feet away from the cable until the size of the spoiling grain mass is large enough to raise the temperature around the volume of the cable 溫度無法偵測數米外微的生長，除非已很大量造成升溫
- These limitations are overcome with CO₂ sensors which help in monitoring stored grain quality 這些限制可用CO₂感應器監控儲存穀物品質

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The CO₂ sensing technology (CO₂偵測技術)



The CO₂ sensor is inserted through the grain storage bin's roof and suspended into the headspace. The CO₂ sensor is connected to the communication box through a cable. The CO₂ sensor automatically records the CO₂ concentration hourly, and depending on the settings sends the data to a server via the wireless telephone network. The user can log into the BinTech website and view a bin's CO₂ trend data over the last few days, weeks or months.

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Sniffing Out Bugs Automatically

Carbon dioxide detector monitors insect infestations in grain storage

Copyright by iStock

Published: Oct 19, 2010

Some 100,000 acres of grain storage bins are in the U.S. during 2010 and 2011. The 2010 crop is expected to be 1.75 billion bushels.

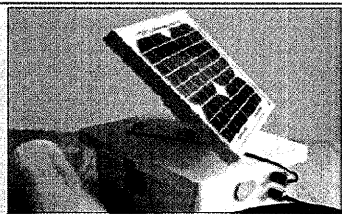
The system detects the slightest release of carbon dioxide within grain storage, so bugs don't have to tell their story. (2) (3) (4) (5) (6) (7) (8) (9) (10) (11) (12) (13) (14) (15) (16) (17) (18) (19) (20) (21) (22) (23) (24) (25) (26) (27) (28) (29) (30) (31) (32) (33) (34) (35) (36) (37) (38) (39) (40) (41) (42) (43) (44) (45) (46) (47) (48) (49) (50) (51) (52) (53) (54) (55) (56) (57) (58) (59) (60) (61) (62) (63) (64) (65) (66) (67) (68) (69) (70) (71) (72) (73) (74) (75) (76) (77) (78) (79) (80) (81) (82) (83) (84) (85) (86) (87) (88) (89) (90) (91) (92) (93) (94) (95) (96) (97) (98) (99) (100)

Sniffing out insects in grain storage bins is a new technology. Suggested list price is \$10,500. Call 800-838-8388, or visit www.gesag.com



GESAG Sniffing Out Bugs automatically in storage grain and more at: www.gesag.com

As a result of our successful research, this technology was introduced at the 2010 Farm Progress Show!



Sniff out pests in your grain storage

PAM'S CHOICE: Grain storage issues plagued many farmers during 2009 and into 2010. As well as Gary Woodruff's marketing OSOs, BinSpector was like the rain-bow after the storm. The BinSpector detects the slightest release of carbon dioxide. Bugs better learn to mind their traps. Messages go to the grower by text. It had been tested by Kansas State University and Purdue University. BinSpector is in limited release for 2010. Suggested list price is \$10,500. Call 800-838-8388, or visit www.gesag.com.

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2011 corn: production forecast 2011年玉米產量預測

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2011 corn: production forecast 2011年玉米產量預測

- U.S. Corn production is forecast at 12.9 billion bushels for 2011-12, (WASDE report 2011) 2011-2012年預期產量為129億蒲耳
- U.S. Corn average yield is forecast at 153.0 bushels per acre against 152.8 bushels in 2010-11 (down 5.7 bushels from July-2011 month's forecast) 平均每英畝生產153蒲耳,較去年低5.7蒲耳
- Total projected U.S. corn use for 2011/12 is 13.16 billion bushels, Corn use for ethanol is projected at 5.1 billion bushels, exports are estimated at 1.75 billion 2011/12預期產量為131.6億蒲耳,其中51億蒲耳供酒精生產,17.5億蒲耳供出口
- U.S. Corn ending stocks are projected at 714 million bushels, stocks to-use ratio is projected at 5.4 percent 庫存約7億1400萬蒲耳(5.4%)
- The season-average farm price for corn is projected at \$6.20 to \$7.20 per bushel 平均價格約6.2-7.2元/蒲耳

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Thanks 謝謝

**Questions?
問題**

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