COMMISSION RECOMMENDATION

of 17 August 2006

on the prevention and reduction of *Fusarium* toxins in cereals and cereal products

(Text with EEA relevance)

(2006/583/EC)

THE COMMISSION OF THE EUROPEAN COMMUNITIES,

Having regard to the Treaty establishing the European Community, and in particular the second indent of Article 211 thereof,

Whereas:

(1) In accordance with Council Directive 93/5/EEC of 25 February 1993 on assistance to the Commission and cooperation by the Member States in the scientific examination of questions relating to food [1], Scientific Cooperation (SCOOP) Task 3.2.10 'Collection of occurrence data of *Fusarium* toxins in food and assessment of dietary intake by the population of EU Member States' [2] was completed in September 2003.

The results of that task demonstrate that *Fusarium* toxins are widely distributed in the food chain within the Community. The major sources of dietary intake of *Fusarium* toxins are products made from cereals, in particular wheat and maize. While the dietary intakes of *Fusarium* toxins for the entire population and adults are often less than the respective tolerable daily intakes (TDI), for risk groups like infants and young children, they are close to or even exceed the TDI in some cases.

(2) In particular for deoxynivalenol, the dietary intake for young children and adolescents is close to the TDI. For zearalenone, attention should be paid to population groups not identified in the task, which might have a regularly high consumption of products with a high incidence of zearalenone contamination. For fumonisins, monitoring results for the 2003 harvest indicate that maize and maize products can be very highly contaminated by fumonisins.

(3) Commission Regulation (EC) No 466/2001 of 8 March 2001 setting maximum levels for certain contaminants in foodstuffs [3] establishes maximum levels for deoxynivalenol and zearalenone and, from the year 2007 onwards, requires, maximum levels to be set for fumonisins and T-2 and HT-2 toxins in cereals and cereal products.

(4) The maximum levels set for *Fusarium* toxins in cereal and cereal products take into account the toxicological evaluation, the outcome of the exposure assessment and the feasibility of achieving such levels. However, it is recognised that all efforts should be made to further reduce the presence of these *Fusarium* toxins in cereals and cereal products.

(5) As regards feed, Commission Recommendation 2006/576/EC of 17 August 2006 on the presence of deoxynivalenol, zearalenone, ochratoxin A, T-2 and HT-2 toxin and fumonisins in products intended for animal feeding [4] recommends increased monitoring for the presence of *Fusarium* toxins in cereals and cereal products intended for animal feeding and in compound feed and provides guidance values to be used in assessing the acceptability of compound feed and cereals and cereal products for animal feeding.

(6) The presence of *Fusarium* toxins in products for animal feed can result in toxic effects in all animal species, affecting animal health, although the susceptibility varies considerably amongst animal species. In order to protect animal health and to avoid adverse effects on livestock production, it is also important to prevent and reduce as far as possible the presence of *Fusarium* toxins in cereals and cereal products for animal feeding.

(7) The cereal chain should therefore be encouraged to adopt good practices to prevent and reduce *Fusarium* toxin contamination and this should be achieved through application of the principles applied uniformly across the Community. The full implementation of the principles as set out in this Recommendation should result in a further reduction in contamination levels.

(8) These principles take into account the 'Code of Practice for the prevention and reduction of mycotoxin contamination in cereals, including annexes on ochratoxin A, zearalenone, fumonisins and trichothecenes (CAC/RCP 51-2003)' adopted by the Codex Alimentarius Commission in 2003,

[1] OJ L 52, 4.3.1993, p. 18. Directive as amended by Regulation (EC) No 1882/2003 of the European Parliament and of the Council (OJ L 284, 31.10.2003, p. 1).

[2] Report available on the Commission's website (DG Health and Consumer Protection) at http://ec.europa.eu/food/fs/scoop/task3210.pdf

[3] OJ L 77, 16.3.2001, p. 1. Regulation as last amended by Regulation (EC) No 199/2006 (OJ L 32, 4.2.2006, p. 34).

[4] OJ L 229, 23.8.2006, p. 7.

HEREBY RECOMMENDS:

That the Member States should take into account the uniform principles set out in the Annex when adopting measures directed at operators in the cereal chain in order to control and manage contamination of cereals by *Fusarium* toxins.

Done at Brussels, 17 August 2006.

For the Commission
Markos KYPRIANOU
Member of the Commission

ANNEX

PRINCIPLES FOR THE PREVENTION AND REDUCTION OF *FUSARIUM* TOXIN CONTAMINATION IN CEREALS

INTRODUCTION

1. Many species of *Fusarium* fungi, which are common in soil, can produce a number of different mycotoxins including the trichothecenes such as deoxynivalenol (DON), nivalenol (NIV), T-2 and HT-2 toxins and some other toxins such as zearalenone and fumonisins B1 and B2. *Fusarium* fungi are commonly found on cereals grown in the temperate regions of America, Europe and Asia. Several of the toxin-producing *Fusarium* fungi are capable of producing two or more of these toxins to a varying degree.

2. While the complete elimination of mycotoxin-contaminated commodities is not achievable at this time, the aim is to minimise the occurrence of these toxins through good agricultural practice. The present principles for the prevention and reduction of *Fusarium* toxins aim to provide uniform guidance for all Member States to consider when attempting to control and manage contamination by these mycotoxins. In order for these principles to be effective, producers in each Member State need to consider these general principles in the light of their local crops, climate, and agronomic practices before attempting to apply them. It is important for producers to realise that good agricultural practices (GAP) represent the primary line of defence in controlling the contamination of cereals by *Fusarium* toxins, followed by the implementation of good manufacturing practices (GMP) during the handling, storage, processing, and distribution of cereals for human food and animal feed. In drawing up national codes of practice based on the general principles and producing specific codes of practice for individual cereal species will improve applicability, particularly for crops such as maize.

3. These principles describe factors that can lead to fungal infection, growth and toxin production in cereal crops at farm level and the methods for their control. It must be emphasised that the planting, pre-harvest and post-harvest strategies for a particular crop will depend on the prevailing climatic conditions, taking into account the local crops and current production practices for that particular country or region. Therefore, all those involved in the supply chain should regularly carry out their own risk assessment to decide the extent of the measures to be taken to prevent or minimise contamination by *Fusarium* toxins.

   Such assessments are particularly appropriate in relation to the type of crop to be grown, such as wheat or maize. The routes of infection and dynamics of toxin formation differ from crop to crop and are affected by agronomic factors. Cropping systems in which maize forms part of the rotation carry a high risk. Wheat and other cereals grown in these rotations or in close proximity to crops such as maize also need careful management and inspection.

4. The contamination of cereals by *Fusarium* toxins can be due to multiple factors. Good practices cannot control all such factors, for example weather conditions. Moreover, not all factors are of equal importance, and there may also be interactions among these different factors resulting in *Fusarium* toxin contamination. It is therefore important to adopt an integrated approach addressing all possible risk factors in a reasoned way. In particular, the accumulation of various risk factors has to be avoided, given the possible interactions amongst them.

   It is also of major importance that experiences gained from previous years with the prevention and formation of *Fusarium* fungi and toxins are reported so that they can be used in determining the measures to be taken to prevent *Fusarium* formation in the following years.

   Procedures should be in place to properly handle, through segregation, reconditioning, recall or redirection of use, cereal crops that may pose a threat to human and/or animal health.

5. The principles set out below address the key factors for the control of *Fusarium* toxin contamination in the field. The most important are: crop rotation, soil management, choice of variety or hybrid and correct fungicide use.

RISK FACTORS TO BE TAKEN INTO ACCOUNT IN GOOD AGRICULTURAL PRACTICES (GAP)

CROP ROTATION

6. Crop rotation is generally an effective way of reducing the risk of contamination depending on the fungal strain and crop variety. It is very effective in reducing contamination for winter cereals in particular. Crops other than grass which are not hosts to *Fusarium* species that affect cereals, such as potatoes, sugar beet, clover, alfalfa or vegetables, should be used in rotation to reduce the inoculum in the field. The planting of consecutive crops of small grain cereals, such as wheat, should only be considered after an assessment of the risks of *Fusarium* infection has been undertaken.

The significant interaction found between the previous crop and soil management has indicated the importance of host crop debris in the life-cycle of *Fusarium* head blight pathogens. When wheat crops were grown following a crop, which is susceptible to *Fusarium* spp. such as maize or cereals, levels of DON were higher. Particularly high DON concentrations were found where maize was the previous crop, since it is an alternative host for *Fusarium graminearum*, which is known to be a potent DON producer. However, DON levels were significantly lower in wheat crops following a *Fusarium* susceptible crop where ploughing was practised, in comparison to wheat crops following a susceptible crop but with minimum cultivation.

CHOICE OF VARIETY/HYBRID

7. Choose the hybrids or varieties most suitable for the soil and climatic conditions and the agronomic practices normally used. This will reduce plant stress, making the crop less susceptible to fungal infection. Only varieties recommended for use in a Member State or particular area within a Member State should be planted in that particular area. Where they are available, grow seed varieties developed for resistance to seed-infecting fungi and insect pests. The choice of variety for its tolerance to *Fusarium* infection should also be based on the infection risk.

CROP PLANNING

8. As far as practical, cropping should be planned to avoid climatic conditions that extend ripening in the field before harvest. Drought stress also has to be considered as a risk factor for *Fusarium* infection.

9. Avoid overcrowding of plants by maintaining the recommended row and intra-plant spacing for the species/varieties grown. Information on plant spacing may be provided by seed companies.

SOIL AND CROP MANAGEMENT

10. Cultivation must pay due regard to the risks of erosion and to good land management. Any practice resulting in the removal, destruction or burial of infected crop residues, such as ploughing, is likely to reduce the *Fusarium* inoculum for the following crop. The soil should be cultivated to leave a rough surface or coarse seed bed to encourage the infiltration of water and minimise the risk of erosion of soil and associated nutrients. If ploughing is being considered, the optimum time for it in the rotation would be between two *Fusarium* susceptible crops. Please also refer to point 7.

11. Whenever possible and practical, prepare the seed bed for each new crop by ploughing under or removing old seed heads, stalks, and other harvest residues that may have served, or may potentially serve, as substrates for the growth of mycotoxin-producing fungi. In areas that are vulnerable to erosion, conservation tillage practices may be required in the interest of soil conservation. In the latter case, particular attention needs to be paid to the management of harvest residues that could be the source of possible contamination of the following crop by *Fusarium* fungi: these harvest residues should be ground as finely as possible during or following the harvest of the preceding crop and incorporated into the soil so as to facilitate their decomposition (mulching).

12. Plant stress should be avoided where possible. Stress can be caused by many factors, including drought, cold, nutrient deficiencies and adverse reaction to materials applied to the crop. In taking steps to avoid plant stress, for example the use of irrigation, steps should be taken to minimise the subsequent risk of fungal infection, e.g. by avoiding spray irrigation during anthesis. Irrigation is a valuable method of reducing plant stress in some growing situations. An optimised nutrient supply is essential to avoid weakness, which can promote *Fusarium* infection, but also to decrease lodging. An area- and plant-specific nutrient supply must be maintained.

13. There is no evidence that insect control has any effect on *Fusarium* head blight of cereals in general. However, the control of insects on maize can reduce the incidence of *Fusarium* ear rot and the resulting fumonisin content of maize. Fungicide seed treatments are effective against many seed-borne and soil-borne seedling blights and seed rots. Preventive measures should be used as far as possible to minimise fungal infection and insect damage to the crop and, if necessary, approved and registered insecticides and fungicides to control toxigenic *Fusarium* fungi can be used as recommended by the manufacturers. Where the use of pesticides is inappropriate, other appropriate practices should be used within an integrated or organic pest management programme. It should be stressed that the timely application of fungicide is crucial to control fungal infestation and should be based on meteorological information and/or crop surveys. Infection commonly occurs at flowering, which means that mycotoxins can be produced. If fungal infection and mycotoxins are subsequently found in the crop, then handling, mixing and use of the grain needs to reflect this.

14. *Fusarium* species have been isolated from a wide range of grasses and broad-leaved weed species and a high weed density has been shown to result in increased infection by *Fusarium*. Weeds in the crop should be controlled by mechanical methods or by the use of registered herbicides or other safe and suitable weed eradication practices.

15. There are data to indicate that lodging has a significant effect on *Fusarium* toxin levels in the grain. Therefore, lodged grain should be avoided at harvest, especially if it is wet and the first signs of sprouting are visible. Avoid the lodging of crops by adjusting seed rates, the rational use of fertilizers and the application of plant growth regulators where appropriate. Excessive stem shortening is to be avoided.

HARVESTING

16. If possible, identify high risk situations using weather and disease monitoring services. Assess the quality of the grain before harvest, taking into account the limitations of representative sampling and quick analysis on site. Where possible, segregate parcels of grain, such as lodged grain, that are known or suspected to have high levels of *Fusarium* infection. If practicable, segregate grain on the basis of both market quality requirements, such as for bread making or for animal feed, and ex-field quality such as lodged, damp, clean or dry.

17. Whenever possible, harvest grain at the appropriate moisture content. Delayed harvesting of grain already infected by *Fusarium* species may cause a significant increase in the mycotoxin content of the crop. Ensure that procedures such as the timely availability of crop-drying resources are in place in case the crop cannot be harvested at the ideal moisture content.

18. Before harvest time, make sure that all equipment and facilities to be used for the harvesting and storage of crops are functional. A breakdown during this critical period may cause grain quality losses and enhance mycotoxin formation. Keep important spare parts available on the farm to minimise time lost due to repairs. Make sure that the equipment needed for moisture content measurements is available and calibrated.

19. As far as possible, avoid mechanical damage to the grain and avoid contact with soil during harvesting. Small, shrivelled grain may contain higher amounts of mycotoxins than healthy normal grain. Removal of shrivelled grain by correct setting of the combine or cleaning after harvest to remove damaged kernels and other foreign matter may help reduce mycotoxin levels. While some seed cleaning procedures, such as gravity tables, may remove some infected kernels, kernels with symptomless infections cannot be removed by standard cleaning methods.

DRYING

20. Either at harvest or immediately afterwards, determine the moisture levels of the crop. Samples taken for moisture measurements should be as representative as possible. If necessary, dry the crop as soon as possible to the moisture content recommended for the storage of that crop. When harvesting wet grains that have to be dried, as is the case with maize in particular, the period between harvesting and drying should be minimised. In such cases, therefore, the harvest has to be planned according to the capacity of the dryers.

21. Cereals should be dried in such a manner that moisture levels are lower than those required to support mould growth during storage. A water activity of less than 0,65 corresponds generally to a moisture content of less than 15 %. More specific guidance on moisture levels should be provided in national codes, taking into account local storage conditions. This is necessary to prevent the growth of a number of fungal species that may be present on fresh grains.

22. Where damp cereals need to be stored before drying, there is a risk of mould growth within a few days, which may be accompanied by heating. Cereals should be dried in such a manner that damage to the grain is minimised. The time period that wet, freshly harvested grain is kept piled or heaped prior to drying or cleaning should be as brief as possible to lessen the risk of fungal growth. Aerate wet grain to avoid overheating prior to drying. Where practical, cereal lots with different risks of contamination should not be mixed.

23. To reduce the variation of moisture content within a lot, the grain may be moved to another facility, or silo, after drying.

STORAGE

24. For bagged commodities, ensure that bags are clean, dry and stacked on pallets or incorporate a water-impermeable layer between the bags and the floor.

25. Where possible, aerate the grain by circulation of air through the storage area to maintain proper and uniform temperature levels throughout the storage area. Check moisture content and temperature of the stored grain at regular intervals during the storage period. Odour can indicate that grain is heating, particularly if the store is enclosed.

26. Measure the temperature of the stored grain at several fixed time intervals during storage. A temperature rise may indicate microbial growth and/or insect infestation. Separate the apparently infected portions of the grain and send samples for analysis. After separation, lower the temperature in the remaining grain and aerate. Avoid using infected grain for food or feed production.

27. Use good housekeeping procedures to minimise the presence of insects and fungi in storage facilities. This may include the use of suitable, registered insecticides and fungicides or appropriate alternative methods. Care should be taken to select only those chemicals that will not interfere or cause harm, depending on the intended end use of the grain, and should be strictly limited.

28. The use of a suitable, approved preservative, for example an organic acid such as propionic acid, may be beneficial for cereals intended for feedstuffs. Propionic acid and its salts are fungistatic and are sometimes used for preserving damp grain on-farm after harvest to avoid heating and moulding prior to treatment. They should be applied promptly with appropriate application equipment to provide even coverage of the whole batch of grain being treated while ensuring good operator safety. If the grain has been treated after a period of damp storage, the use of a preservative is not a guarantee of uncontaminated grain.

TRANSPORT FROM STORAGE

29. Transport containers should be dry and free of visible fungal growth, insects and any contaminated material. As necessary, transport containers should be cleaned and disinfected before use and re-use and be suitable for the intended cargo. Registered fumigants or insecticides may be useful here. Upon unloading, the transport container should be emptied of all cargo and cleaned as appropriate.

30. Shipments of grain should be protected from additional moisture by using covered or airtight containers or tarpaulins. Avoid temperature fluctuations and any actions that may cause condensation to form on the grain, which could lead to local moisture build-up with subsequent fungal growth and mycotoxin formation.

31. Avoid insect, bird and rodent infestation during transport by the use of insect- and rodent-proof containers and other appropriate methods and, if necessary, by applying insect- and rodent-repellent chemical treatments if they are approved for the intended end use of the grain.