ANTIOXIDANT USE IN APPLE AND PEAR STORAGE

PART 1 – REGULATORY SITUATION

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This article is Part 1 of the international survey which compiled the answers regarding the use of 1-MCP on apples and pears. See Part 2 and Part 3 for more information.

CURRENT DPA AND ETHOXYQUIN REGULATORY SITUATION IN THE EU

Regulations governing the use of chemicals to control diseases and disorders of apples and pears in storage are becoming increasingly stringent. Bowing to public pressure, the allowable residue levels of synthetic chemicals on fruit in different countries, especially European Union (EU) countries has been lowered in recent years. Regulatory pressure is manifested in each country's ability to authorize the use of a chemical as well as the setting of a Maximum Residue Limit (MRL), both based on the active ingredient (AI).

The antioxidants diphenylamine (DPA) and ethoxyquin have proven to be very effective in controlling storage scald and have been the main way to control superficial scald for 40 years. Although DPA has been used to control scald in susceptible varieties of apples, it is not equally effective in pears. Ethoxyquin has proved to be more effective than DPA in pears and has proven to be less phytotoxic.

The European Commission (EC) is currently conducting a review of the AI of chemicals used in food production under *EC Council Directive 91/414*. This directive is part of the process of harmonization of food marketing conditions that the EU has been developing. Any commercial formulation (of a plant protection product) can only be authorized for use in a member state if the AI has been authorized by the EC and included in *Annex I of Directive 91/414*.

This review process is long and includes a review of all existing AI, the incorporation of new AI and evaluation of other substances such as organic products. The review is scheduled in four stages. At the end of each stage, the commission will decide to eliminate or to include the AI in *Annex I*.

According to the review, an AI can be categorized as:

1. *Authorized* in the EU (listed in *Annex I*) once it has passed the assessment tests.
2. *Revoked* in the EU (not included in *Annex I*), it is to be recalled.
3. *In review* if a company is providing information to the EC for evaluation. Formulations may be commercially available in the market.
4. *Review not yet begun* when there is not an ongoing evaluation.

Legal Status of Antioxidants in EU Countries

Current EU residue limits for DPA are 5 mg/kg for apples and 10 mg/kg for pears. The limit for ethoxyquin is 0.05 mg/kg for apples and 3 mg/kg for pears.

DPA is considered a pollutant and a health risk, and is classified by some scientists as toxic and potentially carcinogenic in mice. The regulatory situation with regard to DPA has changed recently in Europe. The EC decided on November 30, 2009 not to include DPA in *Annex I* because during the evaluation several problems were identified. In particular, it was not possible to make a reliable assessment of consumer exposure because of missing data on the presence and toxicity of unidentified metabolites of DPA and on the possible formation of *nitrosamines* during the storage and processing of treated apples. Furthermore, no data was available on possible degradation products or the reaction of DPA residues in processed commodities.

It was decided that authorization of products containing DPA is to be withdrawn by May 30, 2010 and all use to expire on May 30, 2011. However, existing MRLs will remain valid until a new version of the regulation is published.

The target date for publishing a new regulation is November 30, 2010. Because there is a large backlog it is possible that the deadline for publication of the *EFSA Reasoned Opinion for DPA* may slip beyond this date. Delayed publication would also delay the review process further which would provide more time to use DPA at the current EU MRL's.

Research is being conducting to address the concern(s) raised in the review that led to the 'no-inclusion' in *Annex I*. DPA has been exposed previously to this process and so far has always been permitted but as a result of this review there is the possibility that DPA use may be revoked.

The suppliers of DPA (XEDA, Decco and Pace International) have formed a working group and believe that positive results will lead to its inclusion in *Annex I*. Pace has been acting mainly in a supporting role to XEDA. They have hired a law firm to refute the decision of the EC of "no-inclusion" and presented two proposals in February 2010. The first proposal is to cancel the decision of the EC to exclude the registration of DPA. If the court rules against the first proposal, the second proposal is to extend the grace period for DPA for two years.

According to information provided by Pace International (Andrew Kieniksman), studies needed to fulfill the data gaps identified by the EC (identification of DPA metabolites in apples in storage and during processing) are underway. The storage study is a 10-month study, but the deadline for gathering the information necessary for the DPA inclusion was May 2010. Thus, a preliminary report will be submitted prior to the deadline until the final report is complete.

The EC has placed DPA under an "accelerated review", which will still take about 15 months. It is unlikely that the EC will make a decision before the current grace period expires and a proposal has been submitted to extend the grace period. Thus, DPA can still be used while under review.

The current tolerance for *imports* of DPA will not immediately be affected by the "no inclusion" in *Annex I* and shall remain effective for 18 months after the expiration of the grace period for DPA, which is in May 2011, so the residue tolerance will remain in place until November 2012. However, if DPA use in EU is eliminated, the EC will likely reject proposals to allow the entry of fruit treated with DPA.

Ethoxyquin Status

The AI for ethoxyquin is also excluded from the list of AI in *Annex I* because no company stepped forward to register it. Commercial supporters have recently come forward so this AI is also now under review. Currently, the information that has been submitted in support of inclusion is being evaluated and formulations continue to be available in the market. If the evaluation is positive, ethoxyquin would be included in *Annex I*. If the ruling is negative, a new regulation of "no inclusion" will be issued, then there will be a period of 18 months from the publication during which time formulations may be commercially available in the market until its withdrawal.

International Survey on Antioxidant Use on Apples and Pears

In light of the potential change in regulations, and the concern of fruit packers who market in EU, a survey of international researchers, suppliers and packers was conducted. The aim was to assess the situation in each fruit growing region, to determine which alternatives to antioxidants are being evaluated, gauge the perception about the acceptability of fruit treated with 1-methlycyclopropene (1-MCP) and learn how much packers of different regions are concerned about scald control.

Responses were received from 47 people: Argentina (1), Australia (2), Brazil (3), Canada (5), Chile (2), Germany (2), Israel (4), Italy (5), the Netherlands (2), New Zealand (1), Portugal (2), South Africa (3), Spain (3), and the United States (12).

The questions asked were:

1. Is this new regulation a concern?
2. What is the local registration status of DPA and ethoxyquin?
3. Are there viable alternatives to antioxidants for scald control?
4. Is there acceptance of 1-MCP treated fruit in the markets?
5. Is there acceptance of 1-MCP treated fruit by consumers?

Concerns over New EU Regulations

Pear scald is a high risk in southern European countries like Portugal, Spain and Italy because they are warm countries with temperatures of 30 to 40 °C in the summer. In *Portugal*, where the main pear variety 'Rocha' is susceptible to scald, respondents are very concerned about the potential ban on DPA especially since ethoxyquin is not registered. They don't know how the pear industry will manage if DPA is withdrawn since it is used to control scald.

In *Brazil*, DPA has not been registered on apples or pears. Brazilians believe that the EU has wanted to ban DPA for some time ago and has moved forward with the ban now that producers have an effective alternative in 1-MCP.

Canadian researchers indicated that there is not much immediate concern since the May 2011 deadline is only for the review of DPA. Canadian researchers have predicted this would happen eventually in EU thus research in recent years has been aimed at developing alternative scald control methods. Researchers did not have information about which markets still allow DPA and ethoxyquin and argue that the situation seems to be changing every month.

In *Israel*, respondents are not worried about the regulations with respect to apples or pears as they don't export these fruits to Europe.

In the *Netherlands,* respondents predict that DPA and ethoxyquin will be banned in the EU member countries, and later on imported fruits.

South African producers are concerned and are actively looking for alternatives for DPA to control scald. They are also looking to apply alternative solutions to other markets.

United States producers have a strong domestic market and exports to Europe are minimal. Europe is an important market for apples from the northwest (Pacific Northwest) but it is not as critical as other markets. The DPA status in Europe is a concern for some researchers, but so far they have not been consulted by industry on how to proceed without DPA. It may be that exporters are confident that other techniques (including 1-MCP) will be available for fruit destined for EU markets. So far they are only aware of these restrictions in Europe and no in other countries. Other researchers have indicated that they had no knowledge about the situation in Europe, and with respect to the United States, there appears to be no concern about the use of DPA and ethoxyquin, except where DPA can contaminate organic fruit.

The exclusion of ethoxyquin from *Annex I* in general was not known by most researchers. Many said they were unaware that ethoxyquin was banned.

Registration status of DPA and Ethoxyquin in Other Countries

In *Argentina*, DPA is used mainly for apples, and ethoxyquin for pears.

In *Israel* both DPA and ethoxyquin are registered, but it is likely that local authorities will follow the example of the EU and sooner or later these products will be removed from the marketplace.

The northern *Italian* producing region of the South Tyrol has decided not to use DPA starting this year, regardless of the decision of the EC. They are confident that scald can be controlled using other technologies.

In some countries there are some particular situations, for example in *Germany*, DPA is not registered for postharvest use, but treated fruit can be imported; this bothers the local industry. In *Serbia*, DPA is not allowed because it was never registered, but many packinghouses use it.

United States producers are using DPA for apples and ethoxyquin for pears, and probably will use them a while longer. In Oregon and Washington ethoxyquin is used on 'Beurre D'Anjou' pears to control scald. It is applied in a drencher, on the packingline or by impregnated paper. Most packers prefer to use ethoxyquin on pears instead of ultra-low oxygen controlled atmosphere storage (CA) because of potential fruit marking at low levels of oxygen.

In the rest of the surveyed countries, only DPA is registered. This is the case of *Chile* and *South Africa*, where ethoxyquin was registered many years ago but is no longer registered. In *Canada*, ethoxyquin is not allowed and DPA is allowed for both apples and pears, but the residues allowed in pears is very low (0.1 ppm). In *Portugal*, ethoxyquin was removed from the market many years ago; in *Spain* ethoxyquin registration was removed this year.

Table 1. Residue limits of pesticides for Apples and Pears expressed in mg/kg (ppm)

	Apple		Pear	
Country	**DPA**	**Ethoxyquin**	**DPA**	**Ethoxyquin**
Argentina	3	NR	3	COAD
Australia	10	3	7	3
Brazil	NR	NR	NR	NR
Canada	5	3	RST	3
China	5			
CODEX	10 (Po)		5 (Po)	3 (Po)
EU	5 (NI)	0.05 (NI)	10 (NI)	3 (NI)
Japan	10	3	5	3
Mexico	10		5	3
Russia	NR	NR	NR	NR
South Africa	10	NR	10	NR
Switzerland	5	0.05	10	0.05
Turkey	5		10	
USA	10 (Pr-Po)	RST	5 (Po)	3

SOURCE: CIATI, June 2010

(Po) postharvest
(Pr-po) pre and postharvest
(Nl) not included in *Annex I, Directive 91/414/EEC*
NR: not registered
RST: registered for other crops, with no tolerance for apples.
COAD: included in the registration of food additives and processing aids.