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National Organic Standards Board
Spring 2011 Meeting
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Re. Antibiotics in Organic Fruit Production

Beyond Pesticides, founded in 1981 as a national, grassroots, membership organization that represents community-based organizations and a range of people seeking to bridge the interests of consumers, farmers and farmworkers, advances improved protections from pesticides and alternative pest management strategies that reduce or eliminate a reliance on pesticides. Our membership and network span the 50 states and groups around the world.

Beyond Pesticides supports the committee recommendations to allow streptomycin to sunset and to deny the petition to remove the expiration date on tetracycline.

There has been controversy over the use of the antibiotics streptomycin and tetracycline in organic fruit production since they were first approved by a split vote in 1995. As laid out in the committee decision for streptomycin, many issues have been raised. Foremost among these have been:

1. The potential for promoting resistance to the antibiotics in human pathogens by spraying them in the orchard environment,
2. Inconsistency with the position on antibiotic use in animals, and
3. Incompatibility with organic and sustainable agriculture.

1. Resistance

We all recognize that resistance to antibiotics among human pathogens is a huge problem. The Centers for Disease Control (CDC) call it, "one of the world's most pressing public health problems."[1] Many bacterial infections are becoming resistant to the most commonly

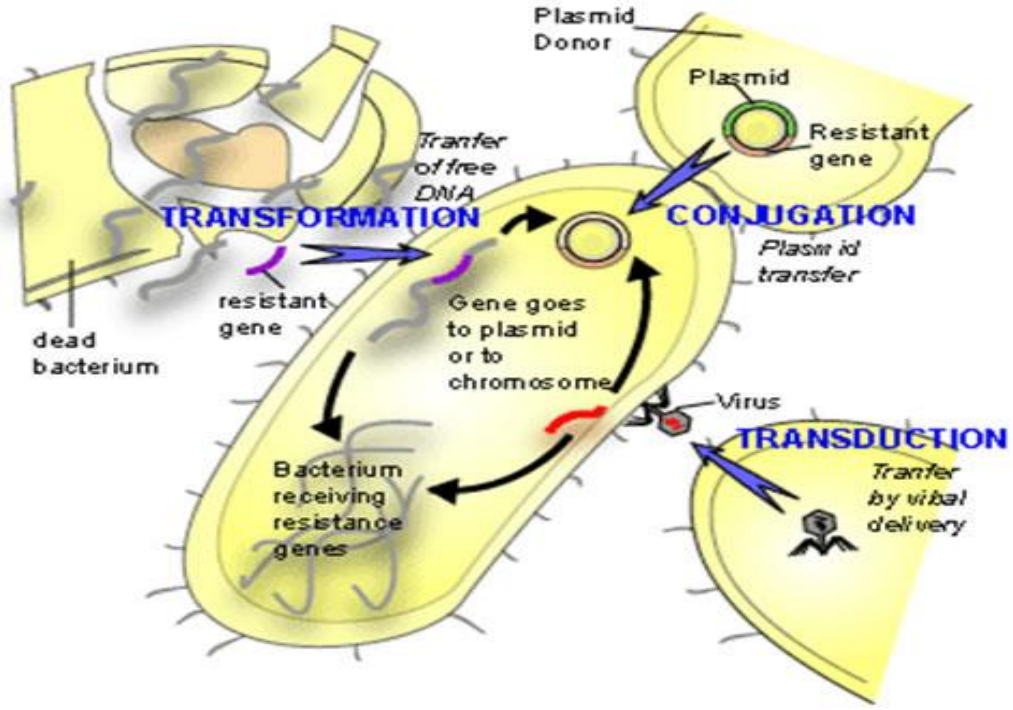
[1] CDC, "Get Smart: Know When Antibiotics Work." http://www.cdc.gov/getsmart/antibiotic-use/fast-facts.html Accessed 3/20/2011.

prescribed antibiotics, resulting in longer-lasting infections, higher medical expenses, and the need for more expensive or hazardous medications. Tetracycline is used for many common infections of the respiratory tract, sinuses, middle ear, and urinary tract, as well as for anthrax, plague, cholera, and Legionnaire's disease, though it is used less frequently because of resistance.[2] Streptomycin is used for tuberculosis, tularemia, plague, bacterial endocarditis, brucellosis, and other diseases, but its usefulness is limited by widespread resistance.[3]

It may not be widely appreciated by this board that use of antibiotics on fruit trees can contribute to resistance to the antibiotic in human pathogens. The human pathogenic organisms themselves do not need to be sprayed by the antibiotic because movement of genes in bacteria is not solely "vertical"—that is from parent to progeny—but can be "horizontal"—from one bacterial species to another. So, a pool of resistant soil bacteria can provide the genetic material for resistance in human pathogens.

The basic mechanism is as follows. If bacteria on the plants and in the soil are sprayed with an antibiotic, those with genes for resistance to the chemical increase compared to those susceptible to the antibiotic. We know that resistance genes exist for both streptomycin and tetracycline, and spraying with these chemicals increases the frequency of resistant genotypes by killing those susceptible to the antibiotic and leaving the others. Those genes may be taken up by other bacteria by a number of mechanisms, collectively known as "horizontal gene transfer." They include *transformation*, in which bacteria pick up DNA that is free in the environment—for example, from dead and degraded bacteria, *conjugation*—from direct cell-to-cell contact, which may involve unrelated bacteria and is mediated by plasmids or transposons, and *transduction*—the transfer of DNA via phage. These are illustrated below.

[2] Tetracycline TR, 2006. Lines 68-71.
[3] NLM (U.S. National Library of Medicine). 2006. Streptomycin sulfate injection, solution. DailyMed website. National Institutes of Health. http://dailymed.nlm.nih.gov/dailymed/drugInfo.cfm?id=2250



Once resistance genes are present in *any* bacteria, they increase the pool of resistance genes and the likelihood that human pathogens will acquire that resistance. The paper, "Emergence, Spread, and Environmental Effect of Antimicrobial Resistance: How Use of an Antimicrobial Anywhere Can Increase Resistance to Any Antimicrobial Anywhere Else," by Thomas F. O'Brien is attached to these comments for further clarification.

The contribution of antibiotic use in fruit trees to resistance may not be nearly as important as the use of non-therapeutic antibiotics in livestock, but it does have an impact on the pool of antibiotic-resistant bacteria, and organic agriculture should not be contributing to the problem. Furthermore, residues of antibiotics in the soil may be taken up by treated or untreated plants and affect bacteria.[4]

2. Inconsistency with Prohibition of Antibiotics in Organic Animal Husbandry

The organic rule (205.238(c)(1) is clear that organic livestock producers may not "[s]ell, label, or represent as organic any animal or edible product derived from any animal treated with antibiotics." This has contributed to reduced rates of antibiotic resistance in bacteria in

[4] K. Kumar, S.C. Gupta, Y. Chander, and C.J. Rosen, 2005. Antibiotic Uptake by Plants from Soil Fertilized with Animal Manure. J. Environ. Qual. 34:2082–2085 (2005).
W.D. Kong, Y.G. Zhu',, Y.C. Liang, J. Zhang, F.A. Smith, and M. Yang, 2007. Uptake of oxytetracycline and its phytotoxicity to alfalfa (*Medicago sativa* L.). **Environmental Pollution**, Volume 147, Issue 1, May 2007, Pages 187-193.
RC Sinha and EA Peterson, 1972. Uptake and persistence of oxytetracycline in aster plants and vector leafhoppers in relation to inhibition of clover phyllody agent, Phytopathology 62: 50-56.
MJ Daniels, 1982. Editorial: Possible effects of antibiotic therapy in plants. Reviews of Infectious Diseases 4 (Supp): 167-170.

animals on those farms.[5] The intention has been to prevent antibiotic resistance by using good preventive health care that can eliminate most need for antibiotics. Even in an emergency, if animals may be treated with antibiotics, they may not be sold as organic. In the case of fruit production, antibiotic use has been allowed, and as shown below, it has resulted in practices that create more need for the chemicals. The program should be consistent in prohibiting the use of antibiotics.

3. Incompatibility with Organic and Sustainable Agriculture

The use of antibiotics in organic fruit production is incompatible with a system of organic and sustainable agriculture for a number of reasons.

First of all, it does not encourage and enhance preventive techniques, including cultural and biological controls. Almost every publication on fire blight stresses that the first line of defense is the choice of disease-resistant varieties and rootstocks. The following table listing resistant and susceptible varieties of apples, pears, and their rootstocks is from a Purdue Extension publication.[6]

Table 1. Fire Blight Resistance of Apple and Pear Varieties Resistance Varieties

Apples

Highly Resistant	Jonafree, Melrose, Northwestern Greening, Nova EasyGro, Prima, Priscilla, Quinte, RedFree, Sir Prize, Winesap
Resistant	Dutchess, Empire, Red Delicious, Goldrush, Haralson, Honeycrisp, Jonagold, Jonamac, Libery, McIntosh, Northern Spy, Novamac, Spartan
Susceptible	Beacon, Cortland, Fuji, Gala, Golden Delicious, Granny Smith, Honeygold, Idared, Jonathan, Lodi, Monroe, Mutsu (Crispin), Paulared, Rome Beauty, Wayne, Wealthy, Yellow Transparent, Zesta!

Apple Rootstocks

Resistant	B.9,* Geneva 11, Geneva 30, Geneva 65, M.7, M.27,* Novole, Robusta
Susceptible	Alnarp 2, Bemali, Bud. 9*, Bud. 118, Bud. 140, C.6 (interstem) M.9, M.9 (interstem), M.26, M.27,* MM.106, MM.111, Mark, Ottawa 3, P.2, P.16, P.22

[5] Schwaiger K, Schmied EM, Bauer J., 2010. Comparative analysis on antibiotic resistance characteristics of Listeria spp. and Enterococcus spp. isolated from laying hens and eggs in conventional and organic keeping systems in Bavaria, Germany. Zoonoses Public Health. 2010 May;57(3):171-80.

[6] J. Beckerman, "Fire Blight on Fruit Trees in the Home Orchard", http://www.extension.purdue.edu/extmedia/BP/BP-30-W.pdf.

Asian Pears

Resistant	Chojuro Kosui, Olympic (Korean Giant), Seuri, Shinko, Shinsui, Singo, Tse Li, Ya Li*
Susceptible	Hosui, Kikusui, Okusankichi, Seigyoku, 20th Century(Nijisseki), New Century (Shinseiki) Ya Li*

Pears

Highly Resistant	Honeysweet, Kieffer, LaConte, Magness, Moonglow, Old Home
Resistant	Seckel, Maxine
Susceptible	D'Anjou, Aurora, Bartlett, Bosc, Comice, Clapp's Favorite, Dutchess

Pear Rootstocks

Resistant	Old Home (OH) Old Home x Farmingdale (except OHxF 51), *P. calleryana*, *P.betulifolaefolia* seedlings
Susceptible	Bartlett Seedling, Quince seedling

*There are studies that provide contradicting data, suggesting that this cultivar, rootstock, or species is susceptible.

Compatibility with sustainable and organic principles requires growers to first choose varieties that are not susceptible to important diseases in their region. Other preventive techniques should be used, including site selection, careful fertilization, adequate spacing, and proper pruning practices. Certifiers should already be requiring that use of a material like streptomycin or tetracycline is a last resort.[7] There are now additional products available for use against fire blight. Serenade Max, Bloomtime Biological FD, BlightBan C9-1 and Blightban A506 are relatively new biological controls. Surround is a kaolin clay product that has had some success in controlling fire blight.[8] Even so, the use of resistant varieties virtually eliminates the threat of tree loss to fire blight. We have seen over the past years a trend towards greater dependence on the antibiotics and a greater concentration of susceptible varieties grown in high densities on susceptible rootstocks.[9] See, for example, the trends in apple and pear

[7] See, for example, Midwest Organic and Sustainable Education Service, "Organic Tree Fruit Certification" at http://www.mosesorganic.org/attachments/productioninfo/fstreefruitcertification.html: "The organic regulation mandates that a specific pest control hierarchy be used. To manage pests and diseases, you must start with cultural controls (i.e planting resistant stock), mechanical controls (i.e screening or netting) or biological controls (i.e. the use of beneficial insects and pheromone disruption). If these methods don't work, document the fact and then natural products can be used. If natural inputs are not effective, then approved synthetics can be used."

[8] Glenn, D. M., van der Zwet, T., Puterka, G., Gundrum, P., Brown. E. 2001. Efficacy of kaolin-based particle films to control apple diseases. Online. Plant Health Progress doi:10.1094/PHP-2001-0823-01-RS. http://ddr.nal.usda.gov/bitstream/10113/12139/1/IND43805958.pdf

[9] PW Steiner, 1998. How Good are Our Options with Copper, Bio-controls and Alliette for Fire Blight Control? WV University Kearneysville Tree Fruit Research and Education Center. http://www.caf.wvu.edu/kearneysville/articles/SteinerHort2.html
M. Longstroth, 2002. The 2000 Fire Blight Epidemic in Southwest Michigan. MSU Extension Horticulture. http://www.canr.msu.edu/vanburen/fb2000.htm

varieties grown by organic growers in Washington in the Granatstein presentation, cited below and attached, pages 11 and 14, and compare to the list above of resistant and susceptible varieties.

The use of antibiotics is not sustainable, since it inevitably leads to resistance, as has been seen with streptomycin in the Pacific northwest. And in the long run, it leads to health problems for everyone on the farm—from the plants to the humans. For a summary of some of these problems, see the appendix to these comments.

Finally, organic consumers understand these things. They understand the importance of the threat of antibiotic resistance. An important reason that consumers buy organic meat is the absence of antibiotics. Organic consumers do not want antibiotics to be used on their fruit. Organic apple and pear growers have missed an opportunity to differentiate themselves from conventional growers. Instead of growing susceptible varieties, they should be educating consumers to know that Gala, Fuji, and Granny Smith apples are most likely to be treated with antibiotics, and that certain other varieties are not.

Sincerely,

Terry Shistar, Ph.D.
Board of Directors

Attachments:
"Emergence, Spread, and Environmental Effect of Antimicrobial Resistance: How Use of an Antimicrobial Anywhere Can Increase Resistance to Any Antimicrobial Anywhere Else" by Thomas F. O'Brien
D. Granastein and J. Kirby, 2010. Organic Tree Fruit Production Trends.

D. Granastein and J. Kirby, 2010. Organic Tree Fruit Production Trends. WSHA Annual Meeting Dec. 6, 2010, Yakima, WA. http://csanr.wsu.edu/publications/presentations/Org_Fruit_Trends_WSHA_2010.pdf

Appendix. Some Findings Regarding Tetracycline

1. Adverse biological and chemical interactions in agro- ecosystem

Shifts fungal-bacterial balance at environmentally relevant concentrations.
Sören Thiele-Bruhn′ and Iris-Constanze Beck, 2005. Effects of sulfonamide and tetracycline antibiotics on soil microbial activity and microbial biomass. *Chemosphere*, Volume 59, Issue 4, April 2005, Pages 457-465

2. Detrimental physiological effects on soil organisms, crops, or livestock

Tetracycline may be genotoxic to plant cells.

Xie, X., Zhou, Q., Bao, Q., He, Z. and Bao, Y. , Genotoxicity of tetracycline as an emerging pollutant on root meristem cells of wheat (*Triticum aestivum* L.). Environmental Toxicology, n/a. doi: 10.1002/tox.20567

3. Undesirable persistence or concentration of the material or breakdown products

Tetracycline may be taken up by plants and appear in all tissues and in exudates.

K. Kumar, S.C. Gupta, Y. Chander, and C.J. Rosen, 2005. Antibiotic Uptake by Plants from Soil Fertilized with Animal Manure. J. Environ. Qual. 34:2082–2085 (2005).

W.D. Kong, Y.G. Zhu′,, Y.C. Liang, J. Zhang, F.A. Smith, and M. Yang, 2007. Uptake of oxytetracycline and its phytotoxicity to alfalfa (*Medicago sativa* L.). Environmental Pollution, Volume 147, Issue 1, May 2007, Pages 187-193.

RC Sinha and EA Peterson, 1972. Uptake and persistence of oxytetracycline in aster plants and vector leafhoppers in relation to inhibition of clover phyllody agent, Phytopathology 62: 50-56.

4. Harmful effects on human health

Workers are at risk of contracting tetracycline-resistant disease and suffering from allergic reactions.TR Lines 163-71, 279-293

As a consequence of the widespread use of tetracyclines, the emergence and spread of tetracycline-resistant bacterial pathogens, among them the foodborne pathogen Salmonella enterica, has become a serious health hazard worldwide.

Lugo-Melchor, Y., Quinones, B., Amezquita-Lopez, B.A., Leon-Felix, J., Garcia-Estrada, R., Chaidez, C. 2010. Characterization of tetracycline resistance in Salmonella enterica strains recovered from irrigation water in the Culiacan Valley, Mexico. Microbial Drug Resistance. 6(3):185-190.

Workers who handle feed with tetracycline have tetracycline-resistant flora in their intestines.

Stuart B. Levy, M.D., George B. FitzGerald, Ph.D., and Ann B. Macone, B.S., 1976. Changes in Intestinal Flora of Farm Personnel after Introduction of a Tetracycline-Supplemented Feed on a Farm. N Engl J Med 1976; 295:583-588.

Developmental toxin listed by the state of California.
http://www.oehha.org/prop65/prop65_list/files/P65single3405.pdf