



THE CENTER FOR FOOD SAFETY

Docket No. APHIS-2012-0030
Regulatory Analysis and Development
PPD, APHIS, Station 3A – 03.8
4700 River Road Unit 118
Riverdale, MD 20737 – 1238

29 April 2013

Comments from Center for Food Safety regarding the Petition for Determination of Non-regulated Status for Freeze Tolerant Hybrid *Eucalyptus* Lines:

- 1) Plant pest risks of Freeze Tolerant *Eucalyptus* lines 427 and 435 to be considered by APHIS in the Plant Pest Risk Assessment (PPRA), and
- 2) Scope of alternatives and environmental impacts and issues to be discussed by APHIS in the Environmental Impact Statement

ArborGen Inc. has petitioned APHIS for non-regulated status for two of their Freeze Tolerant *Eucalyptus* (FTE) lines (427 and 435), and has solicited public comments on the plant pest risks associated with approval of these lines, as well as scoping information for an Environmental Impact Statement (EIS), as announced in the Notices of Federal Register, Vol. 78, No. 39, Wednesday, February 27, 2013, pp. 13309 – 12.

We appreciate the opportunity to participate in the regulatory process.

Sincerely,
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Freeze-tolerant *Eucalyptus* hybrid was produced by genetically engineering line EH1

ArborGen Inc. has genetically engineered a *Eucalyptus* hybrid (*E. grandis* X *E. urophylla*) with a cold-tolerance transcription factor gene from *Arabidopsis thaliana* such that the transformed *Eucalyptus* can survive and grow in colder conditions than the parent hybrid, and with a gene that causes male-sterility. Two of the genetically engineered lines – Freeze Tolerant *Eucalyptus* (FTE) lines 427 and 435 – are before APHIS for determination of non-regulated status. These are the first genetically engineered timber trees to be considered for approval by APHIS, and are also the first fast-growing, commercially viable eucalyptus to be able to withstand such cold weather. As a direct result of the engineered cold-tolerance transgene, the range of foreseeable and intended commercial eucalyptus plantations will expand greatly in the United States, with attendant environmental and

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intertwined socioeconomic impacts that APHIS must assess before deciding whether and/or how to approve deregulation in whole or in part or to deny the petition.

The equivalent non-GE organism to FTE 427 and 435 is EH1

In their assessments, APHIS' primary focus should be on the risks and impacts of FTE 427 and 435 in relation to the comparable non-engineered eucalyptus. As stated in the Environmental Report (Petition at 217), “[g]ranting of non-regulated status would indicate that APHIS-BRS has determined that the genetically engineered (GE) organism is no more of a plant pest risk than an equivalent non-GE organism.” The appropriate “equivalent non-GE organism” is the line that was transformed with cold-tolerance and male-sterility genes to produce FTE 427 and 435: hybrid *E. grandis* X *E. urophylla* line EH1.

Throughout the Petition, ArborGen compares FTE 427 and 435 to a hypothetical non-genetically engineered freeze-tolerant eucalyptus (non-GE FTE) for assessing adverse impacts (although not when analyzing benefits from approving FTE 427 and 435). Non-GE FTE may or may not become available for commercial planting in the future, but they are not now present in the landscape, even though eucalyptus breeding programs have been focused on cold tolerance for over 50 years (Rockwood 2012). Also, non-GE FTE are very likely to have different mechanisms and degrees of freeze-tolerance, and other characteristics that are not comparable to FTE 427 and 435, and they may even be different species of *Eucalyptus*. Non-GE FTE is therefore not the appropriate comparator, EH1 is. EH1 shares all of the characteristics of the engineered lines derived from it except for the added traits, and any unintended target site or genome-wide genetic or epigenetic changes associated with the process of genetic engineering.

APHIS should consider future scenarios that include non-GE freeze-tolerant eucalyptus and other lines or species of GE freeze-tolerant eucalyptus that may be expected to someday overlap the range of FTE 427 and 435, particularly when looking at cumulative and other impacts. Taking these scenarios into account is not the same as using non-GE FTE as the “equivalent non-GE organism”, however.

FTE 427 and 435 can be planted in a wider range than EH1, increasing associated adverse impacts

When compared to EH1, because of the engineered cold-tolerance trait FTE 427 and 435 will be planted over a much wider range in the US, impacting more types of ecosystems and socioeconomic environments. Plantations will displace different land uses. The trees will be adjacent to different species, and will be situated in areas with different fire regimes, hydrology, pests and pathogens, and social and economic conditions. These differences between FTE 427 and 435 and EH1 bear on adverse impacts.

Therefore, APHIS needs to base their assessments on an accurate picture of the full planting range of FTE 427 and 435 because many of the risks and impacts are linked to specific regional environments.

Specifically, the range of the parent line EH1 is restricted by freeze susceptibility to hardiness zone 9 and warmer. According to the latest (2012) USDA hardiness zone map (<http://planthardiness.ars.usda.gov/PHZMWeb/>), this includes central and south Florida, very small coastal areas of the Southeastern states, and the lower parts of Louisiana and Texas. Also, some coastal areas of southern Oregon and California are in hardiness zone 9 so could support EH1 hybrids. Although parts of west Texas, the desert Southwest and inland California are also warm enough for EH1, they are likely to be too dry for this and other subtropical *Eucalyptus* species.

According to test plot data (Petition at 107), FTE 427 and 435 will be able to survive and grow throughout zone 8b, in areas with enough moisture. Thus, the transgene confers the ability upon this hybrid to survive and grow a half-zone further north than EH1, a change that results in a surprisingly large range expansion. This increment of freeze-tolerance will allow planting of commercial eucalyptus – for the first time – throughout the southern parts of South Carolina, Georgia, Alabama and Mississippi; the middle and northern sections of Louisiana, and in a greatly expanded portion of eastern Texas. Zone 8b also extends in the Pacific Northwest (PNW) from the coastal areas through many of the intermountain valleys, greatly increasing the potential range that FTE 427 and 435 can be grown in the west.

In the Petition, ArborGen likely underestimates the potential range increase:

- It appears that the Potential Planting Range Map (Fig. A, Petition at 218) for FTE 427 and 435 is based in part on an outdated map of hardiness zones, since the most recent USDA map shows a greater area in moist areas of zone 8b than does Figure A. In fact, hardiness zones are expected to continue changing, with warmer zones moving north as climate changes, a factor that also needs to be considered by APHIS.
- ArborGen does not include suitable regions of the Pacific Northwest (PNW), stating that “[t]he potential for any significant planting of FTE lines in California and Oregon is very unlikely.” (Petition at 427) They base this conclusion on information that a) there are other crops of higher value in the PNW (Petition at 219) so pulp and energy crops are unlikely to displace these, and b) there is little recent pulp use of hardwoods in the region (Petition at 427). However, these are market-based constraints on planting, not biological ones, and subject to rapid change. For example, there are active programs to promote hardwoods for biofuels in the PNW (e.g. Hines 2011), and if FTE grows faster or has superior characteristics than the poplars and other hardwoods being developed for the PNW now, FTE could replace those species in purpose-grown plantations. Because the environment of the PNW is very different from the southeastern states, APHIS must assess the unique risks and impacts of planting FTE 427 and 435 there, given that the engineered traits give these eucalyptus lines ability to do so.

- Nor does ArborGen include in on the Planting Range Map the hardiness zones warmer than 8b, where FTE 427 and 435 can certainly be grown and may overlap EH1 or other species of *Eucalyptus*, with consequences for plant pest risks such as diseases and hybridization (contrary to Petition at 135). Particularly in zone 9a, and depending on economic considerations, FTE 427 and 435 may be grown as an “insurance policy” against uncommon freezes (Petition at 217).

In all of these new areas where commercial eucalyptus will be able to grow because of transgene expression in FTE 427 and 435, eucalyptus plantations will displace some other land uses. APHIS must consider impacts from the range of possible displacements, including clearing of native vegetation types, such as forests, grasslands, and wetlands; planting of FTE 427 and 435 on land previously in conservation uses; agricultural lands of various types; and conversion of other tree plantations, such as pine. For plantings in zone 9, FTE 427 and 435 may displace other eucalyptus plantations, with consequences for pests and diseases, and for hybridization.

High productivity projected for FTE 427 and 435 may increase rather than decrease conversion of native vegetation types and conservation lands to eucalyptus plantations, with greater impacts

ArborGen’s motto is “More wood, less land”, meaning intensification of wood production per acre by growing high-yielding tree varieties, so that less land is required to get a given amount of product. They propose that by increasing the amount of wood per acre in their plantations, natural forests will be spared since pressure for their use will be alleviated. The end result will be more habitats preserved for wild nature. They also assume that FTE 427 and 435 plantations will mainly displace pine plantations and agriculture, rather than native vegetation and conservation lands.

APHIS needs to carefully consider the validity of these assertions (Lindenmayer et al. 2012, Vandermeer and Perfecto 2007). In particular, the use of FTE 427 and 435 for biomass energy production and for biofuels used domestically, and increasingly exported, is likely to create a market where demand for wood products will drive up prices such that more land of all types is converted to plantations. APHIS can look to other crops and forestry systems driven by demand for energy production for examples of what might happen in the Southeast and PNW if FTE 427 and 435 are approved (German et al. 2011).

For example, increasing productivity of corn combined with biofuels mandates is partly responsible for conversion of Conservation Reserve Program lands and fencerows to corn, with negative impacts on birds and other species (Brooke et al. 2009). Demand is leading to corn following corn more often, with pest and disease increases.

At the global level, oil palms grown for biofuels are displacing native forests, with devastating effects on biodiversity, hydrology, and other social and environmental factors

(Obidzinski et al. 2012). The global market has created a situation where the high productivity of oil palms makes it more likely that natural areas will be destroyed, rather than less likely.

Closer to the impact zone for FTE 427 and 435, when fast-growing pine varieties were adopted in the Southeast, natural vegetation types were converted to these plantations on a massive scale, greatly impacting the environment (Southern Environmental Law Center 2012). APHIS needs to determine what factors led to the displacement of natural areas to pine plantations, and whether similar forces are still at play if FTE 427 and 435 prove to be even more productive than the pines, or to have superior qualities that make them more desirable.

In light of the lessons from these and other crops, APHIS needs to look at the particular economic conditions in the Southeast and PNW that would enhance conversion of different land types to FTE 427 and 435 plantations. For example, already there is a global market for wood pellets from the Southeast for energy production in Europe, with export facilities in place (Faulkner 2013). Many biomass facilities are planned, and cellulosic biofuel process development and facilities are being heavily subsidized. If FTE 427 and 435 can provide better or more abundant raw materials for these facilities than current products, will the ability conferred by the freeze-tolerance trait to grow these trees near production or export facilities create an economic situation favorable to conversion of native vegetation to FTE 427 and 435 plantations?

Foreseeable impacts of FTE 427 and 435 APHIS must analyze and consider in its decision if and how to approve FTE 427 and 435

Impacts that APHIS must analyze and consider in deciding whether and how to approve and/or deny the petition include, but are not limited to, the following examples:

- Reduction of habitat amount and quality for native plants and animals throughout the prospective planting area- including threatened and endangered species – compared to natural forests or plantations of native trees, wetlands, conservation reserve lands, and other uses.

Eucalyptus is not a genus native to North America, and many native plant and animal species will be unable to find suitable food, nest sites, germination sites and other habitat features within *Eucalyptus* plantations (e.g. Barlow et al. 2007). Threatened and endangered species may be at particular risk from replacement of suitable habitat with inferior habitat. In addition, FTE 427 and 435 may provide some habitat requirements, but not others. For example, honeybees may be attracted to the nectar-producing flowers but because of lack of pollen in male-sterile FTE 427 and 435, and absence of other flowering plants from undergrowth suppression, the bees may not be able to get adequate nutrition within the landscape. Other effects on numbers and kinds of pollinators may impact nearby agriculture (Taki et al. 2011). These kinds of non-target effects on beneficial organisms are risks that must

be analyzed and considered in deciding whether and how to approve and/or deny the petition.

- Environmental degradation from management practices in plantations such as pesticide applications, planting and harvesting procedures, fire-suppression practices, and transport of wood products.

For example, best management practices suggest controlling herbaceous and shrubby undergrowth with herbicides to reduce competition and fire risks, and with insecticides and fungicides to control pests and pathogens (Petition at 418, Goodrick and Stanturf 2012). However, birds, insects and other wild animals require food and shelter provided by diverse undergrowth. And pesticides can directly and indirectly harm plants and animals, both on and off site, via drift and runoff. These are risks that must be analyzed and considered in deciding whether and how to approve and/or deny the petition.

- Alteration of soil characteristics (microbial communities, nutritional characteristics, secondary compound profiles), including allelopathy.

Root exudates, decaying roots, leaf and bark litter, and other plant parts from FTE 427 and 435 will be different from those of other plants in the planting area, and may change soil dynamics in ways that impact subsequent land uses (Bernhard-Reversat et al. 2001).

- Fire incidence and severity.

Eucalyptus are known to be highly flammable trees, and under certain conditions, canopy fires in particular can spread quickly causing damage to natural and human environments. Some pine species that may be growing in the same area as FTE 427 and 435 are also very flammable (Goodrick and Stanturf 2012). APHIS must assess these combined risks, in addition to risks from FTE 427 and 435 alone. Also, recommendations for managing fire risks – removing underbrush, for example – will reduce biodiversity.

- Hydrological concerns.

In many parts of the world, eucalyptus has been shown to use more water than other trees, and than other land uses, with impacts on stream flow, ground water, and other hydrological phenomena (Albaugh et al. 2013). Apparently, the water use of FTE 427 and 435 has not been measured, but models indicate that these lines are likely to use much more water than other forest types in the Southeast (Vose et al. 2012). Impacts to ecosystems throughout the potential planting area (e.g. cypress forests, Southern Environmental Law Center 2012), including to habitats of

threatened and endangered aquatic and semi-aquatic species need to be taken into account by APHIS, using a precautionary approach in light of the scientific models.

- Impacts of pulp mills and energy production plants on other forest products and uses.

High demand for FTE 427 and 435 in the expanded planting regions, should they prove to be highly productive and have special properties, coupled with subsidized infrastructure for energy uses, may lead to land use conflicts with wood for building, veneer, and other products losing out. Socioeconomic consequences of this scenario need to be examined, looking at other regions where energy uses predominate for lessons.

- Health effects associated with biomass energy and biofuels production.

Throughout the Southeast and in the PNW, citizens are objecting to the building of biomass energy and biofuels facilities; one of their main concerns is an increase in air and water pollution, with health impacts. Among other sources, nonprofit organizations have built up a wealth of specific information on these impacts that APHIS needs to include and consider in its analysis.

- Health effects from possible hosting of the fungal pathogen *Cryptococcus gattii* by FTE 427 and 435.

Although APHIS has looked at the relationship between *C. gattii* and eucalyptus in previous risk assessments (Petition at 135), the issue needs to be addressed again, given the scale-up and increase in planting range that approval of non-regulated status would trigger. Also, FTE 427 and 435 may occasionally be allowed to mature into large trees (abandoned fields, for example), and may be planted in California and the PNW where unique strains of *C. gattii* have developed.

- Hybrid seed production from cross-pollination of FTE 427 and 435 by compatible species, and possible weediness and invasiveness of progeny.

Alien invasive species are an intractable environmental problem worldwide. It is difficult to keep them from entering ecosystems, and once established, essentially impossible to eradicate them. Keeping prospective invasive species out is the only viable solution. Although most expatriated species of *Eucalyptus* in most parts of the world have not become invasive, there are many notable exceptions. The likelihood of FTE 427 and 435 becoming invasive species, or contributing to the invasiveness or weediness of other species, are plant pest risks that must be thoroughly assessed.

In order for eucalyptus to become weedy or invasive it has to be able to spread outside of cultivation via seeds, either directly or by cross-pollination of compatible species. Although FTE 427 and 435 have GE male sterility, they can still form seeds if cross-pollinated by compatible lines or species. In fact, some seeds did develop

field tests via pollination by the parent line EH1. In some parts of the planting area for FTE 427 and 435 there may be other *E. grandis* X *E. urophylla* lines nearby that could cross-pollinate, or *E. grandis* trees that might have some overlap in flowering period. Abandoned plantations and seed orchards, and isolated trees make it difficult to track just where compatible partners will be. Hybridization may even be more likely in male-sterile trees such as FTE 427 and 435. Also, the GE freeze-tolerance trait may give any hybrids that germinate and grow a fitness advantage and characteristics that make them more weedy – greater freeze-tolerance than their parents, for example, particularly in the medium to long term if the pollen parent was also freeze tolerant but by a different mechanism. (See the comments on potential for weediness through hybridization in Crouch 2009, Abbott et al. 2003)).

Establishment in the wild may also be enhanced by fires that stimulate seed germination (Petition at 122), proximity to waterways, disturbances that expose bare soil, storm events that move seeds, ability to withstand harsher conditions such as cold (Callahan et al. 2013), and other factors. All of these disturbances are likely in the long run, and some may increase in frequency and intensity with global warming. These risks must be analyzed and considered in deciding whether and how to approve and/or deny the petition.

Because the engineered traits may affect fitness of FTE 427 and 435 progeny, it is not possible to predict their invasiveness potential relative to similar species. One parent of the EH1 hybrid, *E. grandis*, is predicted to have a high risk of invasiveness in Florida, but invasiveness of the non-engineered hybrid itself “needs further evaluation” (Gordon et al. 2012). It can take decades for tree species to become invasive, so APHIS should take a precautionary approach and prohibit cultivation or require complete sterility rather than just male sterility before considering approval.

- Spread of plant pests and diseases.

Native members of *Myrtaceae* may be susceptible to diseases that FTE 427 and 435 plantations, abandoned orchards or trees can harbor. For example, there is a state-listed threatened tree in Florida in the same family as eucalyptus: *Myrcianthes fragrans*. A serious fungal disease that attacks members of the family, guava rust (*Puccinia psidii*), is known to infect eucalyptus in the US. In 2011, researchers in Uruguay showed that this disease is able to pass back and forth between *Eucalyptus* and the native Uruguay species of *Myrcianthes* (Pérez et al. 2011). Therefore, increased planting of eucalyptus in the vicinity of *Myrcianthes fragrans* – as might occur when FTE 427 and 435 are planted for freeze “insurance” in Florida– that may become infected with guava rust could pose risks to a state-listed species. This risk to a native species is not in the Petition, although guava rust is discussed as present in Florida. In fact, ArborGen does not mention the presence of any native *Myrtaceae*. There are other members of this family in Florida, as well, and APHIS must determine any similar environmental risks involved.

Also, in the northern parts of the projected planning areas of FTE 427 and 435, trees are likely to die back in some years, or to be injured by freezes, and thus stressed. (Non-FTE Eucalyptus would not be planted now in these areas at all.) Stressed or dead plant tissues can harbor diseases that can then spread to other plants. This issue must be analyzed and considered in deciding whether and how to approve and/or deny the petition.

- Climate change: exacerbation of environmental impacts and plant pest risks.

APHIS must not only examine the effects on climate change of approving FTE 427 and 435, they must also assess role of climate change in causing or exacerbating plant pest risks and environmental impacts. For example, the range of FTE 427 and 435 is likely to increase, impacting different environments. The zone where other *Eucalyptus* varieties and species will overlap FTE 427 and 435 may also change, increasing the risk of hybridization and thus weediness, as discussed briefly above. Weather may become more erratic and extreme, resulting in more droughts, for example, that exacerbate hydrological impacts and fire risks. Increased fires may also increase the weediness of FTE 427 and 435.

Assessment of risks and impacts must be based on the best available information from many sources

Finally, in order to properly assess these risks and impacts of FTE 427 and 435, APHIS must critically analyze information from a variety of sources. Whenever possible, APHIS should consult high-quality independent peer-reviewed research, up-to-date reports in the press and extension bulletins, government studies, and other sources of relevant information. In particular, APHIS must not rely on the “Environmental Report” embedded in the Petition that was commissioned by ArborGen and is strongly biased towards finding no significant impacts. APHIS must also consult with all other federal and state agencies with relevant expertise in these issues and regarding potential impacts, such as the Fish and Wildlife Service.

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