Westhoff Vertriebsgesellschaft mbH Petition (19-099-01p) for a Determination of Nonregulated Status for Petunias Containing the A1 Gene of Maize (A1-DFR petunias)

Environmental Assessment

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ACRONYMS AND ABBREVIATIONS

APHIS	Animal and Plant Health Inspection Service
CAA	Clean Air Act
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations (U.S.)
CWA	Clean Water Act
EA	Environmental Assessment
EFSA	European Food Safety Agency
EO	Executive Order
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
FDA	U.S. Food and Drug Administration
FFDCA	Federal Food, Drug, and Cosmetic Act
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FONSI	Finding of No Significant Impact
FQPA	Food Quality Protection Act
GE	Genetically engineered
GHG	Greenhouse gas
N_2O	Nitrous oxide
NAAQS	National Ambient Air Quality Standards
NASS	National Agricultural Statistics Service
NEPA	National Environmental Policy Act of 1969 and subsequent amendments
NHPA	National Historic Preservation Act
NO_2	Nitrogen dioxide
NOx	Nitrogen oxides
OECD	Organization for Economic Cooperation and Development
OSHA	Occupational Safety and Health Administration
Pb	Lead
PM	Particulate matter
PPA	Plant Protection Act
PPRA	Plant pest risk assessment
SO_2	Sulfur dioxide
T&E	Threatened & Endangered
TSCA	Toxic Substances Control Act
U.S.	United States and its territories and possessions
USDA	U.S. Department of Agriculture
USC	U.S. Code
USFWS	U.S. Fish & Wildlife Service
WPS	Worker protection standards
WTO	World Trade Organization

1 PURPOSE AND NEED

1.1 Westhoff Vertriebsgesellschaft mbH Petition for Nonregulated Status

In April 2019, Westhoff Vertriebsgesellschaft mbH (Westhoff) submitted a petition (19-099-01p) to the U.S. Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS) requesting a determination of nonregulated status for genetically engineered (GE) petunias (*Petunia* x *hybrida* Vilm., referred to as A1-DFR petunias), and any progeny[1] derived from them to no longer be considered regulated under Title 7 of the Code of Federal Regulations part 340 (7 CFR part 340). A GE organism is no longer subject to the requirements of 7 CFR part 340 if APHIS determines that it is unlikely to pose a plant pest risk. A1-DFR petunias (23 events that contain one or more copies of the *A1* DFR gene), have been genetically engineered to express the dihydroflavonol 4-reductase (DFR) enzyme from maize (A1-DFR) allowing the plants to produce the plant pigment pelargonidin, which is a type of anthocyanin pigment, in their flower petals. A1-DFR petunias are currently regulated by APHIS.

As part of the evaluation of Westhoff's petition APHIS has developed this Environmental Assessment (EA) in compliance with the National Environmental Policy Act (NEPA), which requires that Federal agencies consider the potential impacts on the human environment that may derive from proposed actions.

1.2 Purpose of A1-DFR petunias

Flower color is one of the most important characteristics in the commercial success of products in the floriculture industry (Chandler and Sanchez 2012). The three major types of floral pigments are flavonoids, carotenoids, and betalains. Among these, the flavonoids contribute most to the range and type of pigments (colors) in plants. Flavonoids consist of several classes of compounds such as anthocyanins, aurones, chalcones, flavones, and flavonols. Anthocyanins can confer orange, red, magenta, violet, and blue colors to certain plant tissues. Aurones and chalcones are yellow pigments while flavones and flavonols are colorless or very pale yellow. Anthocyanins and flavonols are the pigments responsible for flower color in petunia (Westhoff 2019).

There are three groups of glycosylated anthocyanins responsible for producing flower colors: delphinidin, cyanidin, and pelargonidin. Delphinidins and their derivatives generally produce blue flower color, cyanidins and their derivatives produce red or pink flower color, and pelargonidins and their derivatives produce orange or brick red flower color. Petunia produces cyanidin and delphinidin, but little to no pelargonidin (Meyer et al. 1987) because its own DFR enzyme lacks the proper substrate specificity to produce leucopelargonidin, the precursor for pelargonidin. Thus, the natural color range of petunia flowers lack the orange to brick red color (Westhoff 2019).

A1-DFR petunias were genetically engineered to produce the anthocyanin, pelargonidin, which is produced by many species of flowering plants, but not by petunias. A1-DFR petunias contain the *A1* DFR gene derived from corn. This A1 version of DFR enables the biosynthesis of

[1] APHIS maintains a list of petunia varieties that require APHIS authorization to import (https://www.aphis.usda.gov/biotechnology/downloads/petunia_varieties.pdf).

pelargonidin in the petals of A1-DFR petunias because it has the proper substrate specificity to produce the pelargonidin precursor in the proper genetic background (Westhoff 2019). The presence of pelargonidin confers orange to brick red color in the petals of A1-DFR petunias, providing additional novel flower color options. Petunias containing the *A1* DFR gene have a range of flower colors and patterns expressed due to multiple crosses done over the years (Westhoff 2019).

A1-DFR petunias were also genetically engineered to express the selectable marker gene for the enzyme neomycin phosphotransferase (NPTII). NPTII confers resistance to the antibiotics kanamycin and neomycin (Westhoff 2019). Transformed plants can grow in the presence of these compounds, while the growth of unmodified cells is inhibited. This allows the selection of plants that have the physically linked desired genetic modification and aids the development process for genetically engineered petunia.

1.3 The Coordinated Framework and Regulation of Biotechnology Products

Since 1986, the U.S. government has regulated GE organisms pursuant to a regulatory framework known as the Coordinated Framework for the Regulation of Biotechnology (referred to as the Coordinated Framework). The Coordinated Framework, published by the White House Office of Science and Technology Policy (OSTP), describes the regulatory roles and authorities for the three major agencies involved in regulating GE organisms: the USDA APHIS, the U.S. Environmental Protection Agency (EPA), and the U.S. Food and Drug Administration (FDA). On January 4, 2017, the OSTP, in collaboration with the USDA, EPA, and FDA, released a 2017 update to the Coordinated Framework (USDA-APHIS 2018), and the accompanying National Strategy for Modernizing the Regulatory System for Biotechnology Products (ETIPCC 2017). A more detailed description can be found in the original 1986 policy statement (51 FR 23302) and in the 2017 Coordinated Framework update (US-EPA 2017b).

1.3.1 USDA-APHIS

APHIS regulations at 7 CFR part 340, which were promulgated pursuant to the Plant Protection Act (PPA), as amended (7 U.S. Code (U.S.C.) 7701–7772), govern the introduction (importation, interstate movement, and environmental release) of organisms developed using genetic engineering that may pose a plant pest risk. An organism developed using genetic engineering is also regulated under 7 CFR part 340 when APHIS has reason to believe that the organism may be a plant pest or APHIS does not have sufficient information to determine if the organism is unlikely to pose a plant pest risk. An organism developed using genetic engineering is no longer subject to the plant pest provisions of the PPA or to the regulatory requirements of 7 CFR part 340 when APHIS determines that the organism is unlikely to pose a plant pest risk.

1.3.2 Environmental Protection Agency

The EPA is responsible for regulating the sale, distribution, and use of pesticides, including pesticides that are produced by GE organisms, termed plant incorporated protectants. The EPA regulates pesticides under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) (7 U.S.C. 136 et seq.) and certain GE microorganisms under the Toxic Substances Control Act (TSCA) (15 U.S.C. 53 et seq.). Before a pesticide may legally be used in the United States, the EPA must evaluate the pesticide to ensure that it will not cause unreasonable adverse effects on the environment and a reasonable certainty of no harm to humans when used in accordance with label instructions. Pesticides that complete this evaluation are issued a "registration" that permits their sale and use according to requirements set by the EPA. The EPA must also approve the language used on the pesticide label in accordance with 40 CFR part 158. Once registered, a pesticide may not legally be used unless the use is consistent with the approved directions for use on the pesticide's label. The overall intent of the label is to provide clear directions for effective product performance while minimizing risks to human health and the environment. Under FIFRA the EPA has a standard of reviewing pesticide registrations every 15 years (US-EPA 2011). The Food Quality Protection Act (FQPA) of 1996 amended FIFRA, and set a standard to reassess, over a 10-year period, all pesticide tolerances that were in place when the FQPA was signed, make a safety finding when setting tolerances that the pesticide can be used with “a reasonable certainty of no harm,” take into consideration aggregate and cumulative effects/risks in assessing human health, and emphasize risks to special sub-populations such as infants and children (US-EPA 2015).

The EPA also sets tolerances (maximum limits) for pesticide residues that may remain on or in food and animal feed, or establishes an exemption from the requirement for a tolerance, under the Federal Food, Drug, and Cosmetic Act (FFDCA; 21 U.S.C. 301 *et seq.*). In establishing a pesticide tolerance, the EPA conducts dietary risk assessments to ensure that all tolerances established for each pesticide and food product reach a safety determination based on a finding of reasonable certainty of no harm. The FDA enforce pesticide tolerances set by the EPA to ensure the safety of the nation's food supply.

A1-DFR petunias do not contain a GE pesticide and there is no change to pesticide use, therefore, the EPA has to oversight role over A1-DFR petunias.

1.3.3 Food and Drug Administration

The FDA regulates GE organisms under the authority of the FFDCA (21 U.S.C. 301 *et seq.*). The FDA published its policy statement concerning regulation of products derived from new plant varieties, including those derived from genetic engineering, in the *Federal Register* on May 29, 1992 (57 FR 22984). Under this policy, the FDA implements a voluntary consultation process to ensure that human food and animal feed safety issues or other regulatory issues, such as labeling, are resolved before commercial distribution of GE food. This voluntary consultation process provides a way for developers to receive assistance from the FDA in complying with their obligations under federal food safety laws prior to marketing.

More recently, in June 2006, the FDA published recommendations in “Guidance for Industry: Recommendations for the Early Food Safety Evaluation of New Non-Pesticidal Proteins Produced by New Plant Varieties Intended for Food Use” (US-FDA 2006) for establishing voluntary food safety evaluations for new non-pesticidal proteins produced by new plant varieties intended to be used as food, including plants developed using genetic engineering. Early food safety evaluations help make sure that potential food safety issues related to a new protein in a new plant variety are addressed early in development. These evaluations are not intended as a replacement for a biotechnology consultation with the FDA, but the information may be used later in the biotechnology consultation.

Because A1-DFR petunias are not intended for human and animal consumption and petunias generally are not consumed as food or feed, the FDA does not have regulatory authority over A1-DFR petunias.

1.4 Purpose and Need for APHIS Action

APHIS regulations at 7 CFR part 340 govern the introduction (importation, interstate movement, and environmental release) of GE organisms that may pose a plant pest risk. The regulations provide that any person may submit a petition to APHIS requesting that an organism developed using genetic engineering should not be regulated, because it is unlikely to present a plant pest risk.[2] If, after conducting a Plant Pest Risk Assessment (PPRA), APHIS determines that an organism developed using genetic engineering is unlikely to pose a plant pest risk, the GE organism is no longer subject to the requirements of 7 CFR part 340 and the plant pest provisions of the PPA.

Consistent with the Council of Environmental Quality's (CEQ) NEPA regulations (40 CFR parts 1500-1508) and USDA and APHIS NEPA implementing regulations and procedures (7 CFR part 1b, and 7 CFR part 372), APHIS has prepared this EA to consider the potential impacts of a determination of nonregulated status for A1-DFR petunias on the human environment.[3]

1.5 Public Involvement

APHIS seeks public comment on EAs through notices published in the *Federal Register*. On March 6, 2012, APHIS announced in the *Federal Register* updated procedures for the way it solicits public comment on petitions for determinations of nonregulated status.[4] Details on APHIS policy and procedures for public participation in the petition review and NEPA process are available in the *Federal Register* notice and on the APHIS website.[5]

1.5.1 Public Involvement for Petition 19-099-01p

On July 25, 2019, APHIS announced in the *Federal Register* that it was making Westhoff's petition available for public review and comment to help identify potential environmental and interrelated economic impacts that APHIS should consider in evaluation of the petition.[6] APHIS accepted written comments on the petition for a period of 60 days, until midnight, September 23, 2019. At the end of the comment period APHIS had received a total of nine comments – seven were in support of the Westhoff petition and two were opposed to deregulation. APHIS

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[2] Petitioners are required to describe known and potential differences from the unmodified organism that would substantiate that the regulated organism is unlikely to pose a greater plant pest risk than the unmodified organism from which it was derived.

[3] The human environment includes the natural and physical environment and the relationship of people with that environment. When economic or social and natural or physical environmental effects are interrelated, the NEPA analysis may addresses these potential impacts as well (40 CFR §1508.14).

[4] FR Vol. 77, No. 44, Tuesday, March 6, 2012, p.13258, available at: http://www.gpo.gov/fdsys/pkg/FR-2012-03-06/pdf/2012-5364.pdf

[5] USDA-APHIS, Enhancements to Public Input, available at: https://www.aphis.usda.gov/aphis/ourfocus/biotechnology/SA_Permits_Notifications_And_Petitions/SA_Petitions/CT_Pet_proc_imp_info

[6] Federal Register, Vol. 84, No. 143, July 25, 2019 , p. 35849 – Westhoff Vertriebsgesellschaft mbH; Availability of Petition for Determination of Nonregulated Status of Petunias Genetically Engineered for Flower Color [Docket No. APHIS-2019-0037, www.regulations.gov].

evaluated the comments and integrated the concerns raised into the EA. All comments received on the petition are available for public review at www.regulations.gov, Docket ID: APHIS-2019-0037.

On September 28, 2020, APHIS announced in the Federal Register it was making available the preliminary PPRA, draft EA, and preliminary finding of no significant impact (FONSI) for a 30-day public review and comment period. At the end of the comment period APHIS had received 4 public comments. Three were in support of Westhoff's petition for a determination of nonregulated status for A1-DFR petunias and one was out of scope. No new information was presented to APHIS in the comments that contributed to or altered the analyses presented in the draft EA, thus, none of the comments was deemed substantive in the sense that they warranted a formal response from APHIS. Comments received on the draft EA are available for public review at www.regulations.gov, Docket ID: APHIS-2019-0037.[7]

1.5.2 Issues Considered in the EA

APHIS developed a list of topics for consideration in this EA based on public comments submitted on Westhoff's petition and the scientific literature on floriculture, plant biotechnology, and the environmental sciences. The following topics are commonly identified as relevant to the scope of analysis in an EA (40 CFR § 1508.25):

Commercial Production

- Petunia Production
- Pest and Pathogen Management

Physical Environment

- Soils
- Water Resources
- Air Quality

Biological Environment

- Soil Biota
- Animal and Plant Communities
- Gene Flow and Weediness
- Biodiversity

Human Health Considerations

- Public Health and Worker Safety

Socioeconomic Considerations

- Domestic Economic Environment
- International Trade

[7] https://www.regulations.gov/docket?D=APHIS-2019-0037

In addition, potential cumulative impacts and potential impacts on threatened and endangered (T&E) species are considered, as wells as adherence of the regulatory status decision to Executive Orders, and environmental laws and regulations to which the action may be subject.

2 ALTERNATIVES

NEPA implementing regulations (40 CFR § 1502.14) require agencies to evaluate all alternatives that appear reasonable and appropriate to the purpose and need for the Agency's action (e.g., a regulatory decision). Two alternatives are evaluated in this EA: (1) No Action, denial of the petition, which would result in the continued regulation of A1-DFR petunias, and (2) the Preferred Alternative, a determination of nonregulated status for A1-DFR petunias – approval of a petition.

2.1 No Action Alternative: Deny the Petition and Continuation as Regulated

One of the alternatives that must be considered by APHIS is a "No Action Alternative," pursuant to CEQ regulations at 40 CFR part 1502.14. Under the No Action Alternative, APHIS would deny the petition. A1-DFR petunias and its progeny would remain regulated under 7 CFR part 340. Permits issued or notifications acknowledged by APHIS would be required for the introduction of A1-DFR petunias. APHIS might choose this alternative if A1-DFR petunias posed a plant pest risk or were determined likely to pose a plant pest risk.

This Alternative is not the Preferred Alternative because APHIS concluded that A1-DFR petunias are unlikely to pose plant pest risk (USDA-APHIS 2020). Choosing this alternative would not satisfy the purpose and need of making a determination of plant pest risk status and responding to the petition for nonregulated status.

2.2 Preferred Alternative: Approval of the Petition for Nonregulated Status

Under this alternative, A1-DFR petunias and progeny derived from this event would no longer be regulated under the regulations at 7 CFR part 340. APHIS would no longer require authorizations for introductions of A1-DFR petunias and progeny derived from this event. This Alternative best meets the purpose and need to respond appropriately to a petition for nonregulated status based on the requirements in 7 CFR part 340 and the Agency's authority under the plant pest provisions of the PPA. Because the agency has concluded that A1-DFR petunias are unlikely to pose a plant pest risk (USDA-APHIS 2020), a determination of nonregulated status of A1-DFR petunias is a response that is consistent with the plant pest provisions of the PPA, the regulations codified in 7 CFR part 340, and the biotechnology regulatory policies in the Coordinated Framework. .

2.3 Alternatives Considered but Dismissed from Detailed Analysis

APHIS has evaluated several additional alternatives for consideration. For example, APHIS has considered alternatives that would entail approving a petition request in part, mandatory isolation or geographic restriction of plants developed using genetic engineering and those that were not, and requirements for testing for the presence of plant material from plants developed using genetic engineering in conventional plants.

Based on the PPRA for A1-DFR petunias (USDA-APHIS 2020), experience regulating organisms developed using genetic engineering, and broad general experience with plant varieties, APHIS determined that A1-DFR petunias are unlikely to pose a plant pest risk. Thus, the imposition of testing, release/planting, and/or isolation requirements on A1-DFR petunias would be inconsistent with the Agency's statutory authority under the plant pest provisions of the

PPA, implementing regulations at 7 CFR part 340, and federal regulatory policies embodied in the Coordinated Framework. Because it would be unreasonable to evaluate alternatives absent any jurisdiction to implement them, these additional alternatives stated above were dismissed from detailed analysis in this EA.

2.4 Comparison of the Alternatives

Table 2-1 presents a summary of the potential impacts associated with selection of either of the alternatives evaluated in this EA. Detailed analysis of the affected environment and environmental consequences is discussed in Chapter 3 and Chapter 4, respectively.

Table 2-1. Summary of Potential Impacts for the Alternatives Considered

Analysis	No Action Alternative: Continue to Regulate A1-DFR Petunias	Preferred Alternative: Determination of Nonregulated Status for A1-DFR Petunias
Meets Purpose and Need	No	Yes
Horticultural Production		
Acreage and Areas of Petunia Production	Petunias are primarily grown for the retail market inside greenhouses. Michigan, Ohio, New York, and Pennsylvania are the leading producers of petunia. Petunias have consistently ranked among the five most commonly sold bedding plants and are grown throughout the United States in home gardens and commercial and public landscapes. Current trends in petunia production and use are not anticipated to change.	A1-DFR petunias will provide an additional color variety of petunia and is expected to compete with other color varieties that are currently in production and offered for sale. A determination of nonregulated status for A1-DFR petunias is not expected to change the acreage or areas used for petunia seed and bedding plant production.
Horticultural Practices and Inputs	Horticultural practices and inputs used in petunia production would remain unchanged.	The change in color in A1-DFR petunias does not cause changes in growth habit, temperature tolerances, nutritional requirements, or other factors that would alter horticultural practices used in petunia production.
Physical Environment		
Soils	Growing practices and inputs used for commercial production of petunia that may impact soil resources would not change from those currently used.	The potential impacts of A1-DFR petunias production on soil quality are not expected to differ from the No Action Alternative.
Water Resources	Existing water use and water quality conditions would be expected to be unchanged.	Because A1-DFR petunias are similar to non-GE cultivated petunia, approval of the petition and subsequent commercial production of

Table 2-1. Summary of Potential Impacts for the Alternatives Considered		
Analysis	**No Action Alternative: Continue to Regulate A1-DFR Petunias**	**Preferred Alternative: Determination of Nonregulated Status for A1-DFR Petunias**
		A1-DFR petunias would present the same potential risks to water resources as non-GE cultivated petunia varieties.
Air Quality	Current impacts to air quality associated with petunia production practices would be expected to continue unchanged.	Sources of potential impacts on air quality are the same as those under the No Action Alternative.
Biological Resources		
Soil Biota	Current impacts to soil biota associated with petunia production practices would be expected to continue unchanged.	A1-DFR petunias are not expected to change the practices and inputs used in petunia production that could cause new impacts to soil biota.
Animal Communities	A variety of animal and insect species feed on or use petunia. Mammals and birds may use petunias for food or feed on the insects feeding on petunias. Invertebrates can feed on petunia plants or prey upon other insects as well as using petunia for pollen and nectar sources.	A1-DFR petunias would not require any change to petunia production practices. DFR and associated pelargonidin and NPTII introduced into A1-DFR petunias present negligible risk to wildlife. Potential impacts to animal communities are not anticipated to be different compared to the No Action Alternative
Plant Communities	Because petunia cultivation typically occurs in greenhouses and then plants are transplanted on the grounds of homes, business, and common areas such as parks for ornamental purposes, the plant communities associated with petunia production and use are limited. Potential impacts to plant communities associated with petunia production and use would be expected to continue unchanged. The impacts to plant communities from petunias in commercial or residential areas is not expected to change.	Potential impacts to plant communities are not anticipated to be different compared to the No Action Alternative
Gene Flow and Weediness	Petunia lacks weedy properties. Petunia does not cross with other genera and hybrids of closely related	A1-DFR petunias have been modified for a change in flower color only. The change in color in A1-DFR petunias

Table 2-1. Summary of Potential Impacts for the Alternatives Considered		
Analysis	**No Action Alternative: Continue to Regulate A1-DFR Petunias**	**Preferred Alternative: Determination of Nonregulated Status for A1-DFR Petunias**
	species are rare in nature. No plants among the *Petunia* genera are on the Federal noxious weed list nor are they listed as invasive by any state. Petunia does not spread vegetatively, and roots will not form on discarded parts of a plant under outdoor conditions (Westhoff 2019).	does not cause changes in seed set, pollen availability, growth habit, temperature tolerances, nutritional requirements, or other factors that would alter where it can be grown or the potential for cross pollinating compared to currently available petunia varieties.
Biodiversity	Petunia production in greenhouses is primarily to raise young plants that will be transplanted outdoors in the built environment. Greenhouse production reduces any impacts on biodiversity. As an ornamental plant grown in beds, pots, and hanging baskets, petunia largely relates to biodiversity within the built environment by serving as a food source for pollinators.	A1-DFR petunias would not be expected to change growing practices, and therefore would not likely impact biodiversity any differently than conventional petunia.
Human and Animal Health		
Human Health	Petunias are not a food and not consumed by humans or used for animal feed. Management practices for petunia production, and the associated human health impacts, are expected to continue unchanged.	Potential impacts to human health are not anticipated to be different from those under the No Action Alternative. The EPA WPS will continue to provide the same level of protection as is currently available
Socioeconomics		
Domestic Economic Environment	Petunia production and use are expected to continue much as it is currently.	A determination of nonregulated status for A1-DFR petunias is not expected to adversely impact domestic petunia markets. A1-DFR petunias would provide novel colored flowers. This additional color variety is not expected to result in a significant increase in petunia demand or production in the United States.
International Trade	There would be no impacts on trade under the No Action Alternative.	A1-DFR petunias would be subject to the same international regulatory requirements as currently traded flower varieties, growers looking to export A1-DFR petunias or seeds

Table 2-1. Summary of Potential Impacts for the Alternatives Considered		
Analysis	**No Action Alternative: Continue to Regulate A1-DFR Petunias**	**Preferred Alternative: Determination of Nonregulated Status for A1-DFR Petunias**
		would need to comply with these regulatory requirements. U.S. imports of A1-DFR petunias would no longer require authorization under 7 CFR part 340, otherwise U.S. petunia imports and exports would be unaffected by a determination of nonregulated status to A1-DFR petunias.
Coordinated Framework		
U.S. Regulatory Agencies	Because A1-DFR petunias do not contain a GE pesticide and there is no change to pesticide use and A1-DFR petunias are not intended for human and animal consumption, neither EPA nor FDA have regulatory oversight.	Because A1-DFR petunias do not contain a GE pesticide and there is no change to pesticide use and A1-DFR petunias are not intended for human and animal consumption, neither EPA nor FDA have regulatory oversight.
Regulatory and Policy Compliance		
ESA, CWA, CAA, SDWA, NHPA, EOs	Fully compliant	Fully compliant

3 AFFECTED ENVIRONMENT

The Affected Environment Section provides an overview of the current conditions of those aspects of the human environment potentially impacted by a determination of nonregulated status of A1-DFR petunias. For the purposes of this EA, those aspects of the human environment considered include production practices used for petunia, the physical environment, biological resources, public health, and socioeconomic issues. The geographic extent of the affected environment corresponds to those parts of the United States in which producers and consumers can grow A1-DFR petunias. Petunias are commonly grown from seed and sold as plants for transplanting on the grounds of homes, business, and common areas such as parks. They may be grown both indoors and outside, as well as in containers. Petunias are primarily produced and grown for ornamental purposes.

3.1 Petunia Breeding and Production

Petunias are a perennial plant in its native range, but are generally grown as an annual ornamental plant in home gardens. Petunias were first described by L. Jussieu in 1803 from plants collected from the mouth of the Plata River (South America) (Ferguson and Ottley 1932; Ando et al. 2005). Plant taxonomists consider the genus *Petunia* within the tribe Petunieae and family Solanaceae, which includes commercially important crop plants such as tobacco (*Nicotiana tabacum*), tomato (*Solanum lycopersicum*), and potato (*Solanum tuberosum*). Members of the genus are widely distributed throughout South America and are thought to have originated in southern South America (Olmstead et al. 2008). The biogeographical history and diversification of wild petunias has been reviewed by Fregonezi et al. (2013).

The breeding of petunias for horticultural purposes began in the early 1800s, when petunia seeds from several species were sent from South America to various European countries between 1823 and 1825 (Ferguson and Ottley 1932; Ando et al. 2005). Plants from these species were crossed, resulting in a variety of hybrids, and some of these were considered to be of high value to horticulturists (Ferguson and Ottley 1932).

All current varieties of the common garden petunia (*Petunia* x *hybrida*) are derived from crosses of two species identified as white-flowered *P. axillaris* and purple-flowered *P. integrifolia* (Ferguson and Ottley 1932; Watanabe et al. 1996). Current varieties of petunias have a wide range of flower colors and sizes, and some have specific ornamentation (e.g., fringed single flowers). In the United States, petunia seeds from the hybrids described here and from crosses with other petunia varieties began to be widely distributed, when they became available in seed catalogues during the early 1900's (Formiga 2010).

Petunia Uses and Markets

In the United States for about the last 100 years, petunias have consistently ranked among the five most commonly sold bedding plants. There are over 400 cultivars currently available in U.S. retail and wholesale markets (Kessler 1998). Petunia are commonly sold as annual bedding plants and may be planted by both professional landscape managers and home gardeners. The diversity of available flower colors and forms (e,g., single-bloom, double-bloom and grandiflora) contribute to their popularity with customers who may be motivated by novel characteristics such as new flower colors and shapes. Breeding programs have resulted in increased diversity of flower color in at least three horticultural types (Kessler 1998).

Built Environment and Consumer Uses of Petunia

End consumers include home gardeners, professional landscapers, businesses, non-governmental organizations such as churches, and government-owned facilities, which are located in residential, commercial, urban, and other developed areas. By the built environment, APHIS means all human-created areas where people live and work on a day-to-day basis (e.g., homes, buildings, streets, open spaces, and infrastructure). The built environment represents an important sector of the affected environment for this EA and an important consideration in this NEPA analysis. Bedding plants (both annual and perennial) are a popular feature in suburban and urban landscapes, being widely used in parks, town centers, and private gardens (as planted plants but also in containers/pots and hanging baskets) (Blanusa et al. 2009; Reynolds 2018). Today, the most common annual flower bedding plants produced in the United States are: geranium, impatiens, petunia, begonia, pansies/viola, and marigold (USDA-NASS 2019b).

One example of a government facility's bedding plant selection is the Heirloom Garden surrounding the National Museum of American History, Behring Center, in Washington, D.C., which has a collection of plants that maintain the many varietal types that have been developed by many generations of breeders. This collection contains the violet flowered petunia (*P. integrifolia*) developed in 1831 in England, which is considered by some as an "old-fashion" garden favorite (Smithsonian Gardens nd).

3.1.1 Commercial Growing Practices

Commercially grown petunias (*Petunia* x *hybrid*) are derived from natives to South America (Kessler 1998). Being native to tropical regions petunias are sensitive to cold soil temperatures and are damaged by frost (Gerats and Strommer 2009). Therefore, petunias are grown for retail markets inside greenhouses designed and equipped to maintain optimum growing conditions (Kessler 1998). Production practices involve seed planting, transplanting, pruning, lighting, temperature regulation, irrigation, humidity control, application of fertilizers and plant growth regulators, optimizing growing substrate, and pest and disease control (Kessler 1998, 1999; Ball Horticultural Company 2009; Gautam 2012).

Petunias, like many bedding plants, can be grown successfully in artificial media such as those composed of peat, sphagnum, and river waste (dredged material from river banks) (Benedetto et al. 2006). Some petunia hybrids have been cultivated hydroponically (Dubey et al. 2013). The best results for producing petunias as potted plants has been achieved with growing media comprised of a 2:1 mixture of soil and sewage sludge (Dubey et al. 2013). Potted petunias are widely grown and popular because of their long duration of flowering and overall presentation. Detailed information on the cultivation practices of petunias in greenhouses can be found in Kessler (1998).

Petunia bedding production requires climate controlled, insect- and rodent-free environments. For best germination, seeds are typically sown in a well-drained growth medium and are not covered. The most commonly used method of sowing petunia seeds is by automatic seeding. The optimum pH for petunia media is 5.5 to 6.0 and a soil conductivity below 0.75mmhos/cm. The optimum temperature range for germination of petunia seed is 75-78°F during the first five days after seeding. After germination, the optimum temperature is 65-70°F, after the true leaves first appear Kessler (1998).

As noted above, petunias are commonly grown in home gardens, business landscaping, and in common areas such as parks. They may be grown both indoors and outside, as well as in containers. For outdoor plantings, petunias (grandiflora and multiflora varieties) are planted about 10-12 inches apart, while spreading varieties can be spaced further apart (Kopcinski 2019). Petunias are tender perennials in USDA plant hardiness zones 9 to 11, but are usually grown as annuals elsewhere. They grow best when planted in full sun in rich, well-drained soil (Kopcinski 2019). Petunias grow best when planted in soil warmer than 60°F and danger of frost has passed (University of Minnesota Extension 2018).

3.1.2 U.S. Petunia Production

The USDA National Agricultural Statistics Service (USDA-NASS) tracks floriculture statistics in 17 floriculture producing states that have at least $10,000 in annual gross sales: Alaska, California, Colorado, Connecticut, Florida, Illinois, Michigan, New Jersey, New York, North Carolina, Ohio, Oregon, Pennsylvania, Texas, Virginia, Washington, and Wisconsin (USDA-NASS 2019b).[8] Floriculture products and operations with $100,000 or more in annual sales in the 17 states account for 99% of the total dollar value of floriculture crops but comprise only 44% of all producers (Table 3-1) (USDA-NASS 2019b).

Table 3-1. Number of Producers by Plant Category – 20 Program States: 2015 and 2018*

Category	All Floriculture Products		Propagative (unfinished) Floriculture Materials	
	2015	2018	2015	2018
Annual bedding/garden plants	2,660	2,690	109	124
Potted herbaceous perennial plants	2,180	2,168	84	91
Potted flowering plants	1,648	1,652	92	78
Foliage plants	1,309	1,518	41	58
Cut flowers	444	532	20	16
Cut cultivated greens	257	274	6	6

Source: (USDA-NASS 2019b)

* Operations with $100,000+ sales. Sum of producers by type of crop grown may exceed reported total number of producers because of operations producing more than one type of plant.

Commercial petunia products include annual bedding plants (small plants intended for transplanting directly into the ground, such as in flower beds), and those for potting and hanging baskets which can be maintained both indoors and outside. Commercial production also includes producing seeds for purchase by petunia producers and for direct planting by consumers. In the

[8] The Commercial Floriculture Survey is a census of all known growers with an operation that produced and sold $10,000 or more of product in the 17 Program States. However, detailed crop information is collected from only operations with $100,000 or more in sales. The data in this report for annual bedding and garden plants, potted herbaceous perennials, potted flowering plants for indoor and patio use, foliage plants for indoor or patio use, cut flowers, cut cultivated greens, and propagative floriculture materials are summarized only from growers with $100,000 or more in annual sales. The data summarized in tables showing grower numbers, hired workers, and growing area represent all growers having whole gross sales of $10,000 or more during the calendar year.

20 states, there were 981petunia flat producers in 2015 and 1,056 in 2018 (Table 3-2). In 2015, the 15 states reported 757 producers of petunia sold in pots and 872 in 2018 (Table 3-3). The number of petunia hanging basket producers in 2015 and 2018 was 838 and 984, respectively (Table 3-4) (USDA-NASS 2019b). Based on the number of flats and pots of petunias sold in the United States in 2018 (Table 3-2 and Table 3-3) and assuming 12 inch spacing, even if all those were eventually planted in outdoor flower gardens in the United States, the planted area would be fairly small, about 419 million sq. ft. (~10,000 acres), a small area compared to the total covered area for commercial floriculture crop production of 859 million sq. ft. (USDA-NASS 2019b) and a very tiny fraction of the 319 million acres planted in principle crops in the United States (USDA-NASS 2019a).[9]

Table 3-2. Petunia – Bedding/Garden Plants Sold as Flats –States and Totals: 2015 and 2018 [Operations with $100,000 + sales]

State	Producers		Quantity Sold (1,000 flats)		Percentage of Quantity Sold at Wholesale		Wholesale Price (dollar per flat)		Value of all Sales at Wholesale (1,000 dollars)	
	2015	2018	2015	2018	2015	2018	2015	2018	2015	2018
Alaska	(NA)	9	(NA)	9	(NA)	60	(NA)	4.47	(NA)	40
California	42	33	1,155	1,074	99	98	8.74	8.82	10,095	9,473
Colorado	(NA)	32	(NA)	165	(NA)	92	(NA)	20.58	(NA)	3,396
Connecticut	(NA)	33	(NA)	291	(NA)	96	(NA)	10.11	(NA)	2,942
Florida	(D)	5	(D)	44	(D)	100	(D)	9.03	(D)	397
Hawaii	(D)	(NA)	(D)	(NA)	(D)	(NA)	(D)	(NA)	(D)	(NA)
Illinois	52	54	147	146	81	79	12.31	12.30	1,810	1,796
Maryland	25	(NA)	243	(NA)	98	(NA)	7.93	(NA)	1,927	(NA)
Michigan	189	196	1,385	1,315	86	81	8.65	8.53	11,980	11,217
New Jersey	77	67	368	267	91	88	8.21	10.46	3,021	2,793
New York	135	108	485	174	89	74	9.48	17.83	4,598	3,102
North Carolina	59	45	545	456	97	97	7.99	8.31	4,355	3,789
Ohio	113	125	411	348	76	71	7.7	8.37	3,165	2,913
Oregon	36	31	245	214	92	88	11.67	11.23	859	2,403
Pennsylvania	130	105	236	237	70	78	15.51	10.83	3,660	2,567
South Carolina	9	(NA)	7	(NA)	91	(NA)	10.11	(NA)	71	(NA)
Texas	82	63	868	450	98	92	7.65	8.27	6,640	3,722
Virginia	(NA)	34	(NA)	211	(NA)	97	(NA)	7.49	(NA)	1,580
Washington	25	22	112	253	96	92	10.36	9.65	1,160	2,441
Wisconsin	(NA)	94	(NA)	97	(NA)	54	(NA)	8.01	(NA)	777
Other States	7	-	241	-	100	-	4.85	-	1,168	-
15 State total	**981**	**1,056**	**6,448**	**5,751**	**91**	**88**	**8.76**	**9.62**	**56,509**	**55,348**

[1] D – Information withheld to avoid disclosing data for individual operations
[2] NA – Not available (estimates began in 2018 in Alaska, Colorado, Connecticut, Virginia, and Wisconsin, estimated discontinued in 2018 in Hawaii, Maryland, and South Carolina)
Source: (USDA-NASS 2019b).

[9] U.S. acreage for petunia grown in gardens was estimated based on 5.7 million flats sold of about 50 plants/flat plus 26.8 million pots sold of about 5 plants per pot for a total of 419 million plants, ultimately planted 1 plant per square foot, for a total of 9,619 acres.

Table 3-3. Petunia – Bedding/Garden Plants Sold in Pots –States and Total: 2015 and 2018 [Operations with $100,000 + sales]										
States	Producers (number)		Quantity sold						Value of all Sales at Wholesale (1,000 dollars)	
			Less than 5 inches (1,000 pots)		5 inches or larger (1,000 pots)		total all sizes (1,000 pots)			
	2015	2018	2015	2018	2015	2018	2015	2018	2015	2018
Alaska	(NA)	8	(NA)	46	(NA)	(D)	(NA)	46	(NA)	109
California	34	28	2,514	2,472	943	1,075	3,457	3,547	6,038	5,785
Colorado	(NA)	23	(NA)	164	(NA)	202	(NA)	366	(NA)	1,108
Connecticut	(NA)	29	(NA)	798	(NA)	234	(NA)	1,032	(NA)	2,335
Florida	29	28	2,278	2,663	474	298	2,752	2,961	3,246	2,996
Hawaii	6	(NA)	69	(NA)	(D)	(NA)	69	(NA)	50	(NA)
Illinois	56	60	646	533	197	207	843	740	1,307	1,357
Maryland	24	(NA)	1,692	(NA)	(D)	(NA)	1,692	(NA)	2,893	(NA)
Michigan	110	131	2,664	2,932	1,408	1,666	4,072	4,598	10,259	11,380
New Jersey	50	47	650	345	609	478	1,259	823	2,648	1,955
New York	95	91	610	452	406	390	1,016	842	2,131	1,751
North Carolina	42	41	1,447	1,165	1,996	3,455	3,443	4,620	4,798	8,223
Ohio	103	106	1,028	966	498	355	1,526	1,321	2,415	2,414
Oregon	34	31	824	1,227	127	142	951	1,369	1,495	2,162
Pennsylvania	96	92	593	711	294	412	887	1,123	1,425	1,780
South Carolina	11	(NA)	19	(NA)	3	(NA)	22	(NA)	53	(NA)
Texas	34	28	1,886	507	781	336	2,667	843	3,620	923
Virginia	(NA)	43	(NA)	880	(NA)	828	(NA)	1,708	(NA)	3,238
Washington	33	21	744	615	79	65	823	680	1,158	1,455
Wisconsin	(NA)	65	(NA)	205	(NA)	30	(NA)	235	(NA)	675
Total	**757**	**872**	**17,664**	**16,681**	**7,815**	**10,173**	**25,479**	**26,854**	**43,536**	**49,646**

D – Information withheld to avoid disclosing data for individual operations

NA – Not available (estimates began in 2018 in Alaska, Colorado, Connecticut, Virginia, and Wisconsin, estimated discontinued in 2018 in Hawaii, Maryland, and South Carolina)

Source: (USDA-NASS 2019b)

Table 3-4. Petunia Bedding/Garden Plants Sold as Hanging Baskets – States and Totals: 2015 and 2018 [Operations with $100,000+ sales]										
State	Producers		Quantity Sold (1,000 baskets)		Percentage of quantity sold at wholesale		Wholesale Price (dollar per basket)		Value of all sales at wholesale (1,000 dollars)	
	2015	2018	2015	2018	2015	2018	2015	2018	2015	2018
Alaska	(NA)	9	(NA)	4	(NA)	43	(NA)	15.51	(NA)	62
California	18	16	304	357	99	100	7.75	6.86	2,356	2,449
Colorado	(NA)	26	(NA)	79	(NA)	72	(NA)	9.17	(NA)	724
Connecticut	(NA)	33	(NA)	621	(NA)	96	(NA)	4.41	(NA)	2,739
Florida	(D)	15	(D)	171	(D)	99	(D)	5.33	(D)	911
Hawaii	(D)	(NA)	(D)	(NA)	(D)	(NA)	(D)	(NA)	(D)	(NA)
Illinois	58	56	241	238	84	84	6.12	6.05	1,475	1,440
Maryland	21	(NA)	133	(NA)	97	(NA)	6.92	(NA)	920	(NA)

Table 3-4. Petunia Bedding/Garden Plants Sold as Hanging Baskets – States and Totals: 2015 and 2018 [Operations with $100,000+ sales]										
State	**Producers**		**Quantity Sold (1,000 baskets)**		**Percentage of quantity sold at wholesale**		**Wholesale Price (dollar per basket)**		**Value of all sales at wholesale (1,000 dollars)**	
	2015	**2018**	**2015**	**2018**	**2015**	**2018**	**2015**	**2018**	**2015**	**2018**
Michigan	183	192	1,131	1,502	89	89	5.81	5.83	6,571	8,757
New Jersey	60	55	315	482	90	89	7.08	5.62	2,230	2,709
New York	112	106	523	437	90	87	6.21	5.41	3,248	2,364
North Carolina	47	40	606	533	96	96	5.40	5.39	3,272	2,873
Ohio	119	125	670	397	78	63	7.38	8.46	4,945	3,359
Oregon	34	31	81	138	89	85	14.77	8.86	1,196	1,223
Pennsylvania	100	102	347	369	80	85	6.42	5.80	2,228	2,140
South Carolina	8	(NA)	17	(NA)	100	(NA)	9.02	(NA)	153	(NA)
Texas	45	42	643	443	98	95	4.43	4.50	2,848	1,994
Virginia	(NA)	37	(NA)	227	(NA)	95	(NA)	7.72	(NA)	1,752
Washington	22	21	47	48	90	91	11.40	11.40	536	547
Wisconsin	(NA)	78	(NA)	108	(NA)	50	(NA)	6.19	(NA)	669
Other States	11	-	236	-	100	-	5.16	-	1,218	-
15 State total	**838**	**984**	**5,294**	**6,154**	**90**	**89**	**6.27**	**5.97**	**33,196**	**36,712**

[1] D – Information withheld to avoid disclosing data for individual operations
2 NA – Not available (estimates began in 2018 in Alaska, Colorado, Connecticut, Virginia, and Wisconsin, estimated discontinued in 2018 in Hawaii, Maryland, and South Carolina)
Source: (USDA-NASS 2019b)

3.1.3 Pest and Pathogen Management

Pests of petunias include a variety of insects, mites, slugs and snails both in greenhouses and outdoors (Kessler 1998; Kopcinski 2019; University of California 2019b). Several fungal diseases and viruses occasionally affect petunias. Petunias have been hybridized with disease-resistant varieties to resist several fungal diseases. These hybrids are also more tolerant of temperature extremes and produce more flowers than non-hybrids. (UF-IFAS 2014). Weeds in greenhouses and flower beds can also impact petunias.

One of the main disease problems in petunia production is root rot. Symptoms include a general lack of vigor, slow growth, and black roots or a blackening of the crown. These symptoms can be caused by any one or more of these fungal pathogen genera: *Pythium, Phytophthora, Rhizoctonia, or Thielaviopsis.* Different pathogen-causing rot problems require different treatments. Therefore, correct disease diagnosis is essential to determine the proper treatment (ACES 2004). Damping-off (*Pythium, Phytophthora, Rhizoctonia*) can also cause problems, especially in the seedling stage. *Thielaviopsis* has been reported as a problem under poor cultural regimes (Kessler 1998). Petal blight can be a problem under wet or very humid conditions, and gray mold (*Botrytis* blight) can be a problem on open flowers under humid conditions (Kessler 1998, 1999; Kopcinski 2019). Other diseases in petunias include aster yellows, fasciation, powdery mildew, verticillium wilt, and *Sclerotinia* stem rot (University of California 2019b). These diseases can also occur outside of petunia production once the plants have been transplanted into home gardens.

Many fungicides are registered to control fungal diseases of bedding plants including petunias. Fungicides such as Banrot 40WP (etridiazole and thiophanate-methyl) can be used as a soil or media drench at seeding or transplanting time as a preventive application for many bedding plants including petunia (Scotts 2009). It can help to prevent *Pythium, Phytophthora, Rhizoctonia, Fusarium*, and *Thielaviopsis* root rots. Truban 3G (etridiazole), Terrazole 5G (etridiazole), or Banrot 8G (etridiazole and thiophanate-methyl) can be used as a dry soil mix as a preventive measure against *Pythium* and *Phytophthora* for many ornamental bedding plants in greenhouses (US-EPA 1987; Scotts 2007; US-EPA 2008). Subdue 2E (mefenoxam) is also registered for use on petunias as a soil drench or soil mix at seeding or transplanting or as a soil surface spray to bedding plants in the landscape as a treatment for damping-off and root and stem rot diseases caused by *Pythium* and *Phytophthora* (US-EPA 1993). *Rhizoctonia* on ornamental bedding plants can be controlled with soil drenches of Chipco 26019 50W[10] (iprodione), or Terraclor 75W (pentachloronitrobenzene (PCNB)) applied as a soil drench or broadcast incorporated before planting (ACES 2004; Chemtura 2006). Several varieties of petunia, such as multifloras (varieties with many single, relatively small flowers), are resistant to fungal diseases (Kopcinski 2019).

Several plant viruses can also cause economically significant losses in petunias including: *cucumber mosaic virus*, *tobacco mosaic virus*, *impatiens necrotic spot virus*, *tomato spotted wilt virus*, *tomato ringspot virus*, *tomato mosaic virus*, *beet curly top virus*, *potato virus Y*, *alfalfa mosaic virus*, *tobacco streak virus*, *petunia vein clearing virus*, *broad bean wilt virus*, and *petunia mosaic virus* (Lewandowski et al. 2010; Kim et al. 2014; Bratsch et al. 2017; Oregon State University 2019). These viruses are spread by insects, contact with infected plants, or by contaminated tools (Lewandowski et al. 2010; Kim et al. 2014; Bratsch et al. 2017; Oregon State University 2019). *Petunia hybrida* are commonly propagated by cuttings, so plantlets derived from virus-infected cuttings are also infected (Bratsch et al. 2017). Ninety-nine percent of petunia varieties on the market are F1 hybrids maintained by propagation using cuttings in highly specialized nurseries with very high hygienic standards (Westhoff 2019). To control viral diseases, plants are screened for disease symptoms and removed and destroyed if symptoms are present. Additionally, the spread of pathogens can be reduced when workers wear disposable gloves and wash their hands thoroughly with soap before handling petunias and contaminated surfaces and tools are cleaned with a dilution of bleach or other disinfecting products (Lewandowski et al. 2010; Kim et al. 2014; Bratsch et al. 2017; Oregon State University 2019).

Common insect and arthropod pests of petunia include thrips, aphids, mites, spider mites, foliage-feeding caterpillars such as tobacco budworm and variegated cutworm, leafminers, and white flies (Kessler 1998; University of California 2019b). In addition, snails and slugs damage petunias (Kopcinski 2019).

Mites, such as cyclamen mites (*Stenotarsonemus pallidus*) can cause damage to petunias. The tiny cyclamen mites hide in moist, shady plant areas, such as in unopened leaves or flower buds, and cause stunted, twisted, and distorted foliage at feeding sites and premature flower or bud death. These mites are difficult to treat with pesticides since they live within parts of plants not easily penetrated by pesticide applications (Denmark 2014; Kelsey 2019).

[10] Labeled for use on ornamental bedding plants but not specifically labeled for petunia.

The tobacco budworm (*Heliothis virescens*) also damages petunias. Budworms feed on flower buds, petals and surrounding foliage, chewing small holes in the plant tissue. In relatively warm growing areas, budworm pupae can overwinter in soils and some populations have developed resistance to certain insecticides (Capinera 2018; Kelsey 2019).

Leafminers occasionally attack petunias leaving serpentine streaks on damaged leaves. *Liriomyza trifolii* is the most common leafminer pest of petunias. The adult females puncture the foliage to feed on the fluids, leaving behind a sappy substance. The puncture sites turn white, resulting in a speckled or stippled appearance. Leafminer larvae tunnel between a leaf's upper and lower surfaces. Extensive tunneling activity often stunts plant growth and causes premature leaf drop and can cause an unsightly leaf appearance. The available chemical pesticides do not effectively control leafminer populations. Certain parasitic wasps can partially reduce leafminer populations (CABI 2019; Kelsey 2019).

One way of controlling insect pests in greenhouses is to eliminate weeds under the benches and around greenhouses. Weeds provide hiding and feeding places for many insects, especially whiteflies and aphids, before infesting crop plants. These insects will also feed on weeds while crop plants are being sprayed with insecticide only to return to crop plants later. Several herbicides are registered to control weeds around greenhouses. For example, diquat, glyphosate, and oryzalin, are herbicides registered for use under greenhouse benches for many types of weeds (ACES 2004).

Commercial flower growers use insecticides, fungicides, nematicides, and growth regulators to control pests. Neonicotinoid insecticides and other systemic pesticides are applied to the soil surface as a drench for uptake by plant roots and movement throughout the plant. Pyrethroids are used topically; sprayed on leaves and flowers. Some populations of thrips, whiteflies, and aphids have been documented as showing resistance to pyrethroids. However, pyrethroids are effective for susceptible populations of whiteflies, aphids, mealybugs, caterpillars, scale crawlers, and other insects (Smitely 2015).

In addition to serving as a host for insect pests, weeds in greenhouses and flower beds compete with plants for light, water, and nutrients. Weeds also reduce the aesthetic value of plants. And low growing weeds may maintain moist conditions that are favorable to fungal diseases (Pundt 2018; University of California 2019a). Management typically occurs prior to planting by preparing the soil with small cultivators, hand weeding, broad spectrum pre-plant and/or residual herbicides, and solarization (Pundt 2018; University of California 2019a). Physical barriers such as mulches and ground cloth are also used to prevent weed growth (Pundt 2018; University of California 2019a).

3.2 Physical Environment

The physical aspects of the affected environment include the soil, water, and air resources associated with the production and use of petunia.

3.2.1 Soils

Soils in the affected environment include all those associated with the production and use of petunia. This would include soils or growth media used for the production of plants or seeds for commercial sale, for plant trays, potted plants, and outdoor plant beds.

Soils consist of a mixture of weathered minerals, organic matter, air and water. At any given location, soil properties, such as temperature, pH, soluble salts, amount of organic matter, the carbon-nitrogen ratio, numbers of microorganisms, and soil fauna all vary seasonally, and shifts in these parameters also occur over longer periods. While the planting medium used to produce bedding plants, such as petunia, may be referred to as "soil or potting soil." It is more properly referred to as a plant growth media and may be comprised of sphagnum peat moss, perlite, vermiculite and small amounts of lime and fertilizer (UMD 2018).

In the bedding plant industry in the past, mixtures of soils, compost material, and manure were used and provided good, but inconsistent growing medium. The inconsistency is due to variation in soil types, excessive clay or sand particles, too high or low mineral and chemical composition (Hansen Jr. 1972). As more information became known about the essential elements and watering requirements, the industry replaced these soil mixtures with soilless media in order to provide consistency in the media mixture (Chavez et al. 2008).

In horticulture, "soilless" plant growth media may be used for growing seedlings, plant propagation, and ornamental plant production, particularly for indoor operations. In order to improve bedding plant growth, many non-soil growing mixtures such as perlite, vermiculite, sphagnum peat moss, sand, redwood shavings, and other amendments have been used (Hansen Jr. 1972). To alleviate several bacterial and pathogen problems in the bedding plant industry, the soil mixtures are sterilized with heat (steam) or chemical fumigation (Hansen Jr. 1972). The combination of such materials and appropriate horticultural setting is used by growers to provide a consistent, repeatable product (ACES 2004).

Horticultural concerns regarding soils, particularly for outdoor, field-raised plants, stem from the potential for growing practices (and inputs) to affect soil fertility, erosional capacity, off-site transport of topsoil, pesticides, and fertilizers, as well as disturbance of soil biodiversity (Hansen Jr. 1972). Managing soil fertility is important for optimizing nutrition and achieving sustainable production (Chavez et al. 2008). Growers consider the type and size of containers, soil mixtures, planting dates, fertilizer, temperatures, local market factors, and other considerations when developing their production and marketing strategies (ACES 2004).

Soil mixture consists of solids (organic and/or mineral) and open spaces or pores which contain moisture and air (Hansen Jr. 1972). The size of the pores contributes to the moisture holding capacity of the soil. Soil bed pH is a key element for dissolved nutrient uptake in plant production (Fisher and Argo 2007). Growing media pH alters the chemical availability of nutrients for root uptake by plants. Several nutrients are affected by growing media pH, including phosphorus and many micronutrients, especially iron, manganese, copper, zinc, and boron (which decrease in solubility at high pH), and molybdenum (which increases in solubility at high pH) (Fisher and Argo 2007). Petunias grow best at a lower pH range of 5.4-6.2 because of increased availability of micronutrients, especially iron, at this lower pH range (Fisher and Argo 2007).

3.2.2 Water Resources

Water resources in the affected environment include all those that could possibly be affected by petunia production and cultivation. That would include effects on water quantity or water quality related to sources or receiving waters along the life cycle of the petunia product, from commercial production of seeds or plants to the consumer use. Such sources and receiving waters could include surface or groundwater sources or municipally supplied or otherwise delivered water or wastewater service.

The U.S. nursery and greenhouse industry is concerned with the challenges of reduced water availability and increased pressure to mitigate water pollution from horticultural production. Growers rely on fertilizers and pesticides, as well as irrigation water, to produce high quality products for markets. The potential contamination of surface and groundwater from runoff containing inputs from production can be a challenge for the nursery/greenhouse operators (Alem et al. 2015). For example, excess nitrates and phosphates from fertilizer are potential environmental hazards if they enter groundwater or surface water through leaching or runoff (Cox 2018). Petunia produced in greenhouses, for the bedding plant market, are grown in containers with a limited amount of substrate, from which water and nutrients are rapidly depleted (James and van Iersel 2001; Rouphael et al. 2008). Thus, frequent irrigation and fertilization may be required to sustain high growth rates needed to meet market demands (Cabrera 2005). Nutrient management practices include matching fertilizer applications with plant nutrient needs to maximize quality, and limiting loss of nutrients from plant containers from top watering or irrigation by containing the effluent (Cox 2018). Alem et al. (2015) showed that growers can adjust fertilizer and water content to manipulate growth and development in petunias and grow high-quality petunias with lower fertilizer rates than commercially recommended rates (Alem et al. 2015).

Many states now require a water discharge permit to control irrigation runoff, as well as regulation of groundwater withdrawals (Fulcher et al. 2016). Laws and regulations limit nursery water consumption in California, Florida, North Carolina, Texas, and Oregon and are expected to become more stringent (Fulcher et al. 2016). Permits regulate the level of discharge that flows into surface waters and groundwater use/access (Fulcher et al. 2016; Texas A&M 2019). Although permits differ somewhat from state-to-state, there are some common features:

- Usually 3-5 years in duration
- Must retain all irrigation runoff
- Must retain all or part of storm runoff (usually first 2″)
- Must dispose of irrigation runoff
- No pesticides discharged
- Nitrate and Ammonia discharge < 2ppm
- Discharge pH between 6 and 9
- Acceptable level of suspended solids

Many operations are required to capture storm water runoff from production areas. Homeowners as well may choose to capture or “harvest” rainwater for landscape and garden use (Waterfall 2006). Reuse or recycling of runoff is becoming a more common production practice. Water-recycling technology has been adopted by some nursery producers to improve crop water productivity and to enhance water supply security (Cao et al. 2017). Careful monitoring of salts, chemicals, nutrients, and pH are critical in managing water resources. Treating recycled runoff is also an important part of this process (Texas A&M 2019).

Due to the potential impacts of agriculture/horticulture on water resources, various national and regional efforts are underway to reduce non-point source contaminants in run-off, and run-off itself, such as the EPA's Mississippi River/Gulf of Mexico Hypoxia Task Force (US-EPA 2017c) and USDA-NRCS National Water Quality Initiative (USDA-NRCS 2019a). The EPA provides specific advice for reducing pollution from yards (US-EPA 2019c).

3.2.3 Air Quality

The EPA establishes National Ambient Air Quality Standards (NAAQSs) pursuant to the Clean Air Act (CAA) that are intended to protect public health and the environment. NAAQS are established for six criteria pollutants: ozone (O_3), nitrogen dioxide (NO_2), carbon monoxide (CO), sulfur dioxide (SO_2), lead (Pb), and particulate matter (PM) (US-EPA 2019b). The EPA determines if the air sheds within each state are either in attainment or in nonattainment for each criteria pollutant under the NAAQS. For air sheds that are in nonattainment, the EPA requires states to prepare a state implementation plan containing strategies to achieve and maintain the national standard of air quality. State plans also must control emissions that drift across state lines and harm air quality in downwind states (US-EPA 2019d).

Certain horticultural activities can affect air quality by releasing particulates, gases, and other chemicals into the air. Emissions released from horticultural production (e.g., use of fertilizers and pesticides, energy production) include carbon dioxide, nitrogen oxides (NOx), reactive organic gases, particulate matter, and sulfur dioxide (FAO 2013). Nitrous oxide (N_2O) may also be released following the use of nitrogen fertilizer (FAO 2013).

While the EPA establishes NAAQS, the standards do not set emission control requirements for any particular industry, including horticulture. The USDA and the EPA provide guidance for regional, state, and local regulatory agencies, and farmers, on how to best manage agricultural emissions sources and limit NAAQS pollutant emissions (USDA-EPA 2012). These measures allow stakeholders the flexibility in choosing which measures are best suited for their specific situations/conditions and desired purposes. The USDA Environmental Quality Incentives Program Air Quality Initiative provides financial and technical assistance to help farmers and ranchers limit air pollution. The EPA has developed USDA-approved measures to help manage air emissions from cropping systems to help satisfy state implementation plan requirements. The EPA recommends that in areas where agricultural activities have been identified as a contributor to a violation of NAAQS, USDA-approved conservation systems and activities may be implemented to limit emissions.

3.3 Biological Environment

The biological aspects of the affected environment include the soil biota, animals, plants, and biodiversity that would be impacted by petunia production.

3.3.1 Soil Biota

Outside of greenhouses where petunias are grown as annual bedding plants, petunias are planted in a variety of environments, ranging from rural, suburban, and urban yards, to city parks and municipal buildings. Petunia plants could interact with and possibly affect soil biota in any of these places where it occurs.

Soil biota (i.e., earthworms, nematodes, fungi, bacteria) play key roles in soil formation, structure, organic matter content, biodegradation of pesticides, suppression of plant pathogens, promotion of plant growth, nutrient cycling, and a wide range of biochemical soil processes (Parikh and James 2014). Microorganisms interact directly with plants through symbiotic relationships that provide nutrients to plants while plants supply carbon and other elements to microorganism(s). For example, arbuscular mycorrhizal fungi (AMF) form a symbiotic relationship with petunia plants by colonizing the roots. They are considered natural biofertilizers because they provide the host plant with water, nutrients, and pathogen protection, in exchange for photosynthetic products (Nouri et al. 2014). On the other hand, some soil based microorganisms are plant pathogens and can cause plant diseases that can result in yield and economic losses. For petunia, these include fungal and viral plant pathogens (Section 3.1.3).

The primary factors affecting soil biota populations and diversity are soil type (texture, structure, organic matter, aggregate stability, pH, and nutrient content), plant type (plants provides specific carbon and energy sources to substrate soil), and horticultural practices such as pesticide and fertilizer application, and irrigation. Pesticides (namely fungicides) used on plants can, relative to the dosage, duration, and frequency of exposure, potentially impact soil communities.

3.3.2 Animal Communities

Animals and animal communities in the affected environment include all those that are present where petunia is grown. The types of animals that feed on or use petunia include invertebrates, mammals, birds, amphibians, and reptiles.

Invertebrates that use petunia include both beneficial pollinator species such as bees and moths as well as pest species. Petunia species are pollinated by bees and hawk moths. Scent or visual cues, including the tubular flower shape and width, seems to play a role in attracting the pollinators, which is a subject of investigation (Gübitz et al. 2009). Invertebrate pests that forage on petunia include thrips, aphids, mites, spider mites, fungus gnats, leafminers, shore flies, white flies, variegated cutworm, tobacco budworm, snails, and slugs (Kopcinski 2019; University of California 2019b) (see Section 3.1.3 Pest and Pathogen Management).

Several types of mammals are known to forage on petunia and discussions among home gardeners and extension services include exchanges of advice to prevent foragers such as squirrels, voles and mice, but especially rabbits and deer, from eating their petunias (Pierce 2015; Hoyt 2018; Sanders 2019). Deer will feed on the foliage as well as flowers (Penn State Extension 2017). Various birds, such as goldfinches, fox sparrows, and dark-eyed juncos consume the seeds of petunias (Georgia DNR 2019). Hummingbirds are known to visit some petunias as a source of nectar (Marshall et al. 2012; Linhart 2014; Sheehan et al. 2015). Chickens may peck at petunias while feeding on insects (Hoyt 2018). Additionally, mammals and birds may feed on the insects that are found on petunias.

3.3.3 Plant Communities

Plants and plant communities in the affected environment include all those present where petunia are grown. In general, all current garden petunia varieties are presumably based on crosses of white-flowered *P. axillaris* and purple-flowered *P. integrifolia*. There are no species in the

Petunia genus that are native to the United States, although there are several introduced[11] (naturalized) species that derived from *Petunia* plants/seed brought to the United States during the early 1900s (Table 3-5) (Figure 3-1).

Table 3-5. Species of Naturalized *Petunia* and Related Flowering Plants in the United States

Scientific Name	Common Name	Genus	Family	States
Petunia x *hybrida* = *Petunia atkinsiana* D. Don ex Loudon [axillaris × integrifolia]	petunia	*Petunia*	Solanaceae	L48
Petunia axillaris (Lam.) Britton, Sterns & Poggenb.	large white petunia	*Petunia*	Solanaceae	L48
Petunia integrifolia (Hook.) Schinz & Thell. (= *Petunia violacea*)	violet petunia	*Petunia*	Solanaceae	L48, PR
Calibrachoa parviflora (Juss.) D'Arcy	seaside petunia	*Calibrachoa*	Solanaceae	L48

HI = Hawaii, L48 = lower 48 states, PR = Puerto Rico, VI = U.S. Virgin Islands
Source: (USDA-NRCS 2019b)

[11] Introduced plants reproduce spontaneously in the wild without human help. The PLANTS database uses the term introduced since it is widely known rather than the similar term naturalized USDA-NRCS. 2019b. *PLANTS Database* U.S. Department of Agriculture, Natural Resources Conservation Service. Retrieved from https://plants.sc.egov.usda.gov/java/ .

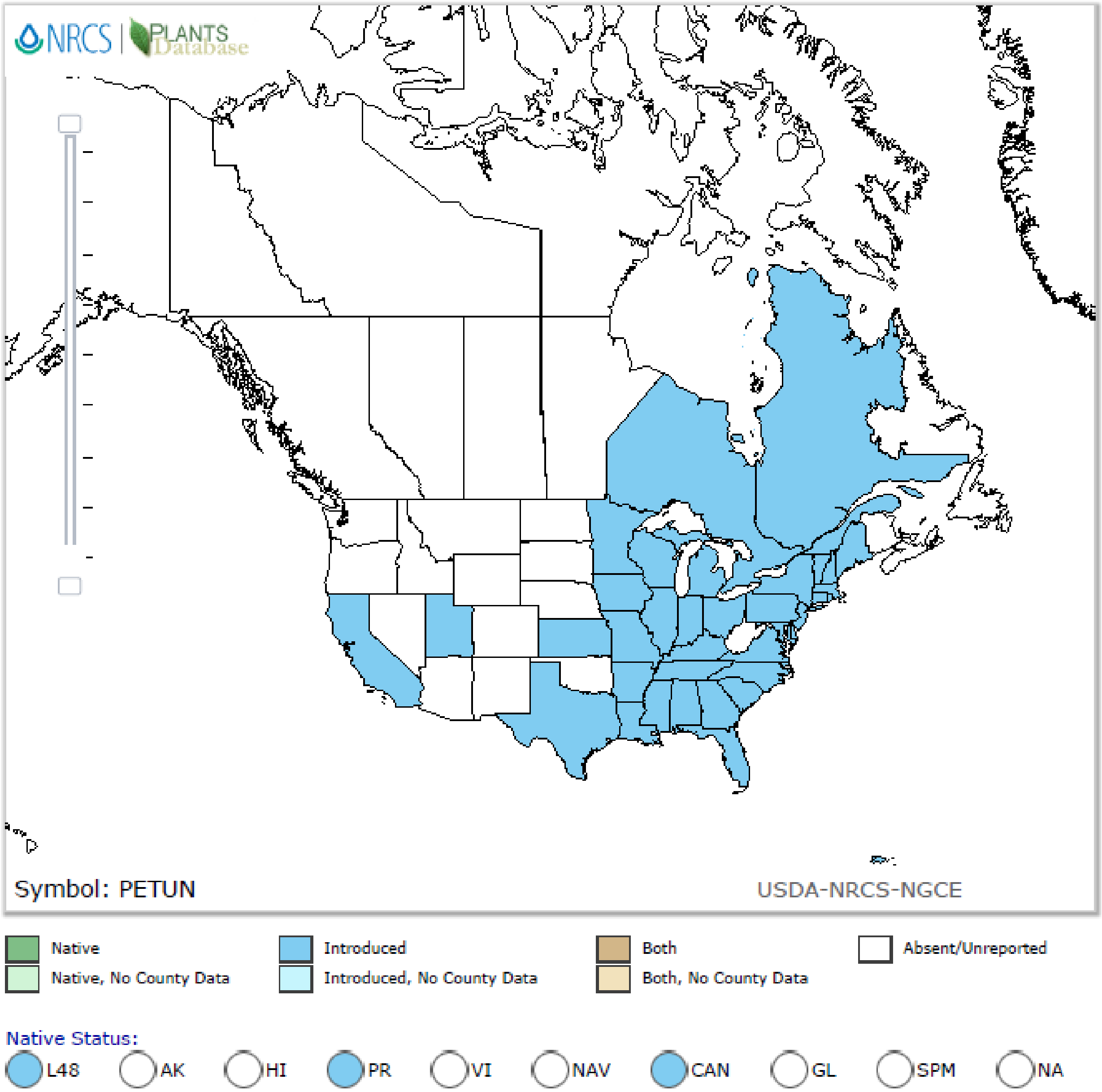

Figure 3-1. Distribution of Introduced *Petunia* Species in the United States and its Territories
Includes *Petunia* x *hybrida* = *Petunia* × *atkinsiana* D. Don ex Loudon [*axillaris* × *integrifolia*], *Petunia axillaris*, *Petunia integrifolia.* Source: (USDA-NRCS 2019b)

The genus most closely related to *Petunia* is *Calibrachoa* (COGEM 2017). Seaside petunia, *Calibrachoa parviflora* (Juss.) D'Arcy, is sometimes used synonymously with *Petunia parviflora* Juss. However, while *Calibrachoa* was included in the genus *Petunia* in earlier taxonomic lists, Wijsman (1990) separated these plants into two groups, based on chromosome number and morphological characters (Jędrzejuk et al. 2017). The USDA Plants Database lists *Calibrachoa parviflora* as introduced in the United States (lower 48 states). However, other sources list it as native in Texas, New Mexico, Arizona, California, and Utah (Figure 3-2) (LBJWC 2009; USDA-NRCS 2019b).

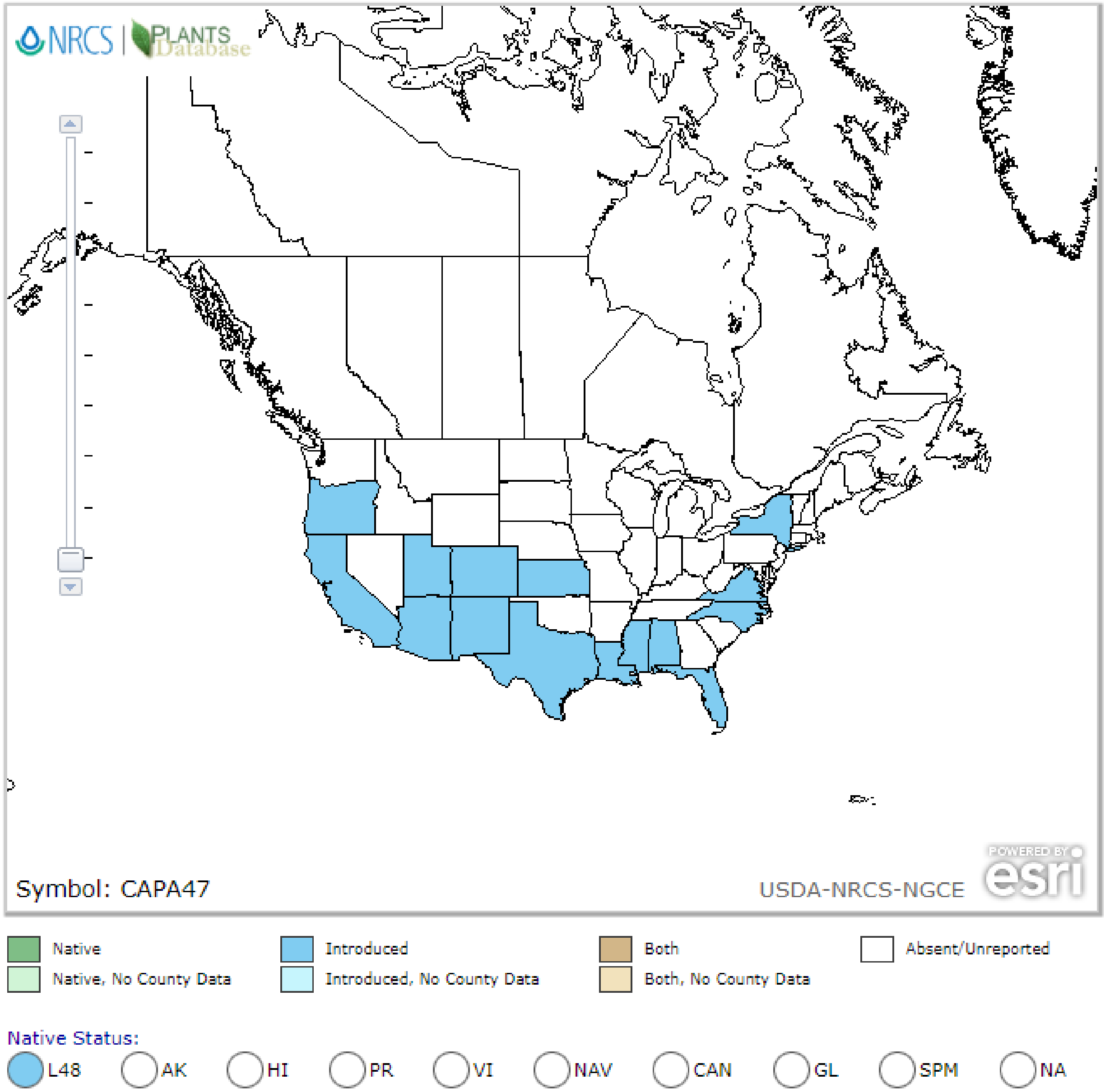

Figure 3-2. Distribution of Native and Naturalized *Calibrachoa parviflora* Species in the United States and its Territories
Source: (USDA-NRCS 2019b)

Introduced petunias can be found along roadsides, edges of fields, areas along railroads, cracks along urban sidewalks and roadside curbs, edges of garden beds, vacant lots, and waste ground (Hilty 2017).

Because commercial petunia cultivation typically occurs in greenhouses, the plant communities associated with petunia production are limited. Broadleaf and grass weeds in the greenhouse can compete with petunias; and they also serve as a primary reservoir of aphids, whiteflies, thrips, mites, and slugs and can be a primary inoculum source for several important greenhouse plant diseases (Pundt 2018). So weed management is encouraged as a way to reduce insect pressure

(ACES 2004). Common greenhouse weeds include chickweed, oxalis, bittercress, dandelion, ground ivy, creeping wood sorrel, prostrate spurge, and grasses (Pundt 2018). It is recommended to not only keep greenhouses free of weeds, but to also maintain a 10 to 20-foot weed-free barrier around the greenhouse (Pundt 2018).

Once petunias are planted in flower beds, weeds compete with petunias for light, water, and nutrients. Weeds also reduce the aesthetic value of these beds. Management typically occurs prior to planting by preparing the soil with small cultivators, hand weeding, broad spectrum pre plant and/or residual herbicides, and solarization (Pundt 2018; University of California 2019a). Physical barriers such as mulches and ground cloth are also used to prevent weed growth (Pundt 2018; University of California 2019a).

3.3.4 Gene Flow and Weediness

Gene flow can occur between organisms of the same species, or among closely related species or genera that are sexually compatible. Gene flow is a biological process that facilitates the production of hybrid plants, introgression of novel alleles, and evolution of new plant genotypes. A hybrid is the offspring of two genetically dissimilar but sexually compatible species, generally within the same genus, although hybrids between different genera are possible. Hybrids can then in turn cross with original parental type individuals. Through this process, called introgression, over several generations novel alleles (genes) can be transferred (flow) from one species to another. These processes can occur by as a part of intentional plant breeding programs or without human actions among certain plant populations.

Gene flow in plants can occur via pollen, seed, or via vegetative propagules. While petunias are often propagated by cuttings in breeding facilities (Vandenbussche et al. 2016; Bratsch et al. 2017), petunia does not naturally spread vegetatively, e.g., petunias do not produce organs such as stolons, rhizomes, root borne shoots, tubers, corms, or runners. Thus, gene flow in nature (outside of breeding facilities) would only occur via cross-pollination and seed dispersal.

Factors Affecting Gene Flow and Dissemination

The rate and success of gene flow is dependent on numerous factors. General factors related to pollen-mediated gene flow include the presence, abundance, and distance of sexually-compatible plant species; overlap of flowering phenology between populations; the method of pollination and pollen transfer; the characteristics and amount of pollen produced; and weather conditions, including temperature, wind direction and intensity and humidity. Seed-mediated gene flow also depends on many factors, including the absence, presence, and magnitude of seed dormancy; contribution and participation in various dispersal pathways; and environmental conditions and events.

Flowering plants often depend on animal pollinators, and these "partnerships" in turn depend on floral traits such as petal color, scents, flower shapes, timing and location of blooms on the plants, and nectar types. In nature, pollination in petunia species depend on bees, hawk moths, or hummingbirds for pollination (Vandenbussche et al. 2016). In many cases flower color serves as a primary characteristic that determines what pollinator species may be attracted to a plant. For example, *P. integrifolia* has small purple flowers that produce hexose (a type of sugar)-rich nectar and is pollinated by bees (Ando et al. 2001; Fregonezi et al. 2013), *P. axillaris* has white flowers with a long corolla tube and produces a strong scent at night and is pollinated by hawk moths (*Manduca sexta*) (Ando et al. 2001; Hoballah et al. 2007), and *P. exserta*, with red flowers, is hummingbird-pollinated (Linhart 2014). For petunia pollinated by bee species, flowers visited by larger bees have relatively open and short floral tubes, while those pollinated by smaller bees tend to have long narrow floral tubes (Linhart 2014). Although *P. integrifolia* and *P. axillaris* generally have different pollination schemes—bee and hawk moth pollination, respectively, field studies have shown that *P. axillaris* is effectively pollinated by certain species of pollen-collecting bees, in addition to hawk moths. However, the main pollinators of *P. integrifolia* were observed to be small bees that were closely associated with *P. integrifolia*, and rarely visited *P. axillaris* (reviewed in (Gübitz et al. 2009)). Although both petunia species were visited by bees, there was little overlap observed in the groups of bees visiting both species. This was in part considered a factor in the low frequency of cross-pollinations observed in natural and artificial populations. While studies have shown that minor pollen transfer may take place with bee pollination, pollinator isolation is a significant factor, after geographic isolation, in development of hybrids.

In addition to color, flowering time, floral tube shape, and aroma, variances in ultraviolet (UV) light absorbance among petunia species also contributes to attraction of pollinator species. Hawk moths prefer white flowers that absorb higher levels of UV light (not perceived by humans) over those that reflect UV light (Sheehan et al. 2015). Differences in UV absorbance in petunia species have been reported from changes in a single gene, *MYB-FL,* a transcription factor (Sheehan et al. 2015). One mutation in *MYB-FL* upped the levels of UV-absorbing compounds called flavonols within the flower petals in species such as *P. axillaris*. A different mutation disabled *MYB-FL*, which led to a loss of UV absorbance on *P. exserta* (Sheehan et al. 2015). Thus, *P. axillaris* with high levels of UV-absorbing flavonols attracts more hawk moths for pollination than those with lower levels of flavonols attractive to other pollinators (Sheehan et al. 2015). Similar types of R2R3 MYB transcription factors are involved in pollination syndrome shifts, e.g. transitions in anthocyanin levels and scent volatiles; and analysis of quantitative trait loci suggest at least a dozen genetic loci are involved in explaining major differences in floral color, UV absorbance, scent and nectar production and morphology (Sheehan et al. 2015).

<u>Weediness of Petunia</u>

All species of the *Petunia* genus have 14 chromosomes and are sexually compatible with and readily crossable with *Petunia x hybrida* (Watanabe et al. 1996). However, hybrids of closely related *Petunia* species are mostly rare in nature with varying degrees of fertility (Jędrzejuk et al. 2017). Species within the *Petunia* genus do not intercross with species in other genera, even the most closely related genus *Calibrachoa* (species with 18 chromosomes). Crosses between *Petunia* and *Calibrachoa* under natural conditions or after artificial pollination were not successful (Wijsman 1983; Ando et al. 2001; Jędrzejuk et al. 2017). In addition, where mixed populations of *Petunia* and *Calibrachoa* species occur, intergeneric hybrids have not been observed. Despite having the same pollinator species, a bee, (*Leioproctus* subgen. *Hexantheda* sp.), crossing experiments and field observations have confirmed that the two genera do not hybridize (Ando et al. 2001; COGEM 2017; Jędrzejuk et al. 2017).

While Petunia do not cross with species in other genera under field conditions, there are several commercial hybrids derived from crosses between *Petunia* and *Calibrachoa* (NGA 2013; Olschowski et al. 2013; Jędrzejuk et al. 2017). For example, "Petchoa" is a *Petunia* and

Calibrachoa hybrid available on the U.S. market (NGA 2013). The methods that were used to produce these hybrids were not published. They may include; human directed sexual crosses or protoplast (somatic) fusion[12] (Olschowski et al. 2013; Jędrzejuk et al. 2017). It should be noted that the interspecific varieties on the market are sterile and do not set seed (NGA 2013; Jędrzejuk et al. 2017), and have a semi-trailing compact growth habit and a strong vigorous root system like petunias (NGA 2013). Analysis of 'Supercal' varieties of Petchoa showed that they are triploid, and two sets of chromosome were derived from *C. parviflora* and the other from Petunia (Jędrzejuk et al. 2017).

Once pollinated, petunia species produce ~60–200 seeds per plant. Petunia species can reproduce in 3–3.5 months, or 4 generations in a year in a conducive environment of relatively high temperatures and long days (up to 16 hr light/day) (Vandenbussche et al. 2016). Petunia seeds disperse by falling close to the mother plant (Stehmann et al. 2009). In terms of movement, petunia seed distribution would extend to areas where people planted them. Seed dormancy is an important characteristic often associated with plants that are weeds (Anderson 1996). Some petunia lines have dormancy and others do not; it is possible, in some environmental conditions and in some lines, to induce secondary dormancy in *Petunia x hybrida* (Girard 1990). Girard (1990) suggests that it is possible to store petunia seeds indoors and they will still be viable after 2-3 years, but the longevity of seeds in the soil is likely to be much less, since the seeds rapidly lose viability when they become exposed to moisture and so are unlikely to persist under normal environmental conditions (Girard 1990).

Petunia is not considered to be a weed. There no plants among the *Calibrachoa* or *Petunia* genera on the Federal noxious weed list nor are they listed as invasive by any state (USDA-NRCS 2019c). Petunia does not spread vegetatively, i.e. the plant does not produce organs such as stolons, rhizomes, root borne shoots, tubers, corms, or runners. Roots will not form on discarded parts of a plant under outdoor conditions (Westhoff 2019).

3.3.5 Biodiversity

Biodiversity refers to the variety and variability of living organisms and the complex, integrated ecological systems in which they occur (Wilson 1988). Ecologists employ several indices to measure biodiversity; these generally include the number of different species present, the turnover of species across time and space, as well as the physical structure of an ecosystem and food web structure. Within the context of biodiversity, organisms are organized at many different levels, ranging from whole ecosystems to microscopic biota, as well as the genomes that define genera and species. Increased biodiversity tends to correspond to greater ecosystem resilience and stability (Ives and Carpenter 2007).

Reductions in biodiversity can result from land use changes that lead to habitat loss and habitat fragmentation, which can derive from suburban/urban development, introduction of non-native or invasive species, and expansion of agricultural lands (USDA-FSA 2010).

As an ornamental plant planted in beds, and used in pots and hanging baskets, petunia largely relates to biodiversity within the built environment. In urban and suburban environments, non-

[12] A type of genetic modification in plants by which two distinct species of plants are fused together to form a new hybrid plant with the characteristics of both, a somatic hybrid.

native horticultural or ornamental plants can serve as an important food source for pollinators. While petunias are not native to the United States, they may support biodiversity by providing food for pollinators, and habitat for various insect species that utilize flowering plants with similar growth habit and structure. For example, petunia provides food for bees (pollen, nectar), hawk moths (nectar), and potentially hummingbirds (nectar), and consequently, particularly given the varied pollinators among petunia cultivars, petunia may help support biodiversity where it is grown. All cultivars of petunia provide nectar, although the potential value to insects is considered greater in the multiflora varieties than the grandiflora varieties as the former has been observed to contain more nectar in flowers, and have smaller flowers, making the nectar accessible to a wider range of insects, including shorter-tongued bee species. The multiflora flower is also less liable to dilution of nectar by rain or dew (Corbet et al. 2001). In general, the nectar of multiflora petunia varieties should be accessible to honeybees and all bumblebee species, whereas nectar of grandiflora petunia can be reached only by the bee species of *Bombus terrestris*, *B. pascuorum*, and *B. hortorum* (Corbet et al. 2001).

While petunia can provide pollen and nectar, other ornamental flowers are more commonly preferred for nectar if present in the area. For example, one study examining ornamental varieties found that few insects foraged on petunia whenever other nectar rich species such as *Calendula* spp. and *Lythrum salicaria* were present (Corbet et al. 2001).

While non-native plants can support environmental (i.e., erosion control, habitat features) and economic interests (i.e., landscaping, horticulture industry), non-native ornamental plants are generally not recommended for planting in or near natural or semi-natural habitats, nor in farmland (outside of farm gardens) (Moorman et al. 2017).

"Natural ecosystems" may be biologically diverse. However, densely populated and human-dominated areas may also be diverse. New York City, New York for example, contains 26 distinct ecological habitat types and 1,450 native plant species (McPhearson et al. 2013). Building resilience into urban built landscapes is an active area of research and creative planning. Designers may have goals that range from the aesthetic to direct and indirect environmental goals, such as creating park-like spaces on roof tops, insulating buildings, and providing pollinator habitat. Designs may be placed in areas that are not typically used for planting, such as roof tops, living walls, parking areas, and roadway sides and thereby increase biodiversity in the built environment. The selection of plant materials for these settings will depend upon a wide range of overarching site-specific factors, cost considerations, and preferences.

3.4 Human Health

3.4.1 Consumer Health

Human health considerations associated with plants developed using genetic engineering (principally crops) are those related to (1) the safety and nutritional value of plants developed using genetic engineering and their products to consumers, and (2) the potential health effects of pesticides that may be used in association with plants developed using genetic engineering. As for food safety, consumer health concerns can be related to the potential toxicity or allergenicity of the introduced genes/proteins, the potential for altered levels of existing allergens in plants, or the expression of new antigenic proteins. Consumers may also be concerned about the potential consumption of pesticides on/in foods derived from plants developed using genetic engineering. Occupational exposure to pesticides can also be a concern.

Certain ornamental flowers are edible such as borage blossoms, calendula, zucchini blossoms, hibiscus petals, lavender, nasturtium, pansies, rose, sage flowers, and violets. Petunia are not considered edible flowers nor are they used as a feed ingredient. Any potential human health considerations related to petunia would include those arising from contact with plant parts (e.g., allergens or chemical or mechanical injury from contact with plant tissue) as well as worker exposure to chemical inputs used in petunia production. A developer may choose to voluntarily consult with the FDA as to the safety of their product, as discussed in Section 1.3.

As discussed in Section 1.3, the EPA has oversight of pesticides and protection of human and environmental health from potential pesticide hazards. Any pesticides used in the production or rearing of petunia are subject to EPA review, registration, and label use requirements. States may also regulate certain pesticide practices deployed in petunia production.

3.4.2 Worker Safety

Horticultural service workers are at risk of injury from a variety of potential hazards, including exposure to chemicals, machinery, lifting, and construction. Horticultural hazards are addressed in specific Occupational Safety and Health Administration (OSHA) standards for General Industry (29 CFR part 1910).

The EPA established the Worker Protection Standard (WPS) (40 CFR part 170) in 1992 to reduce the risk of pesticide poisonings and injuries among pesticide handlers and applicators. The WPS applies to horticultural workers and contains requirements for pesticide safety training, notification of pesticide applications, use of personal protective equipment, restricted entry intervals following pesticide application, decontamination supplies, and emergency medical assistance.

In November 2015, the EPA issued revisions to the WPS regulations intended to enhance the protections provided to agricultural workers, pesticide handlers, and other persons by strengthening elements of the existing WPS such as training, pesticide safety and hazard communication information, use of personal protective equipment, and the providing of supplies for routine washing and emergency decontamination (80 FR 211, November 2, 2015, p. 67496).

In September, 2016 the EPA in conjunction with the Pesticide Educational Resources Collaborative made available a guide to help users of agricultural pesticides comply with the requirements of the 2015 revised federal WPS. Agricultural workers and handlers, owners/managers of agricultural establishments, commercial (for-hire) pesticide handling establishments, and crop production consultants are advised to employ this guidance. The updated 2016 WPS How to Comply Manual supersedes the 2005 version.[13]

All pesticides must be used in strict accordance with their label instructions. All pesticides labeled for use in the United States must be evaluated for safety and registered by the EPA. Worker safety precautions and use restrictions are clearly noted on pesticide registration labels.

[13] https://www.epa.gov/pesticide-worker-safety/pesticide-worker-protection-standard-how-comply-manual

Growers are required to use pesticides consistent with the application instructions provided on the EPA-approved pesticide labels. These restrictions provide instructions as to the appropriate levels of personal protection required for agricultural workers to use pesticides. These may include instructions on personal protective equipment, specific handling requirements, and field reentry procedures. These label restrictions carry the weight of law and are enforced by the EPA and the states (FIFRA 7 U.S.C. 136j (a)(2)(G) Unlawful Acts); therefore, it is expected that pesticide use would be consistent with the EPA-approved labels.

3.5 Socioeconomics

3.5.1 Domestic Economic Environment

The 2018 National Agricultural Statistics Service data, for the floriculture industry as a whole, indicated a $1.46 billion market value for annual bedding and garden plants and potted flowering plants were valued at $876.7 million (USDA-NASS 2019b). Among bedding and garden plants, petunias are among the top 10 types produced. In 2018, producers collectively sold 5.8 million petunia flats at a wholesale market value of $55.3 million, 26.9 million petunia pots at a wholesale market value of $49.6 million, and 6.2 million petunia hanging baskets at a value of $36.7 million (USDA-NASS 2019b).

As detailed in Section 3.1 – Petunia Breeding and Production, petunia is commercially produced in many states. Michigan, Ohio, New York, and Pennsylvania are the leading states in terms of number of producers. In 2018, there were 1,056 producers of nursery flats in the United States, 984 of hanging baskets, and 872 of pots (USDA-NASS 2019b). Thus, there are numerous producers, and petunia production is important to local economies in many states. Michigan, California, North Carolina, and Ohio are the leading states in terms of total value of all sales at wholesale, accounting for over 50% of the total wholesale revenue (USDA-NASS 2019b). It should be noted that USDA data only captures those operations with over $100,000 in sales, smaller producers are not included in these production and sales data.

3.5.1.1 Ornamentals developed using genetic engineering

Several cut flower varieties developed using genetic engineering are currently produced: 19 varieties of carnation (*Dianthus caryophyllus*), 1 rose (*Rosa × hybrida*), and 1 baby's breath (*Gypsophila* spp.) (USDA 2016). Most distributors, flower auctions, brokers, wholesalers, floral designers, and consumers are not aware that these varieties are developed using genetic engineering (Anderson and Walker 2013).

Biotech carnation (*Dianthus caryophyllus*) products were first marketed in Australia in 1997 and are now authorized for import in the European Union, Japan, Canada, Malaysia, Singapore, and the United States (Chandler and Sanchez 2012; Suntory 2015; AU 2018). Carnations developed using genetic engineering are currently produced in Colombia and Ecuador, and then exported as cut flowers to approving countries. More than 4 million of these carnations are sold world-wide each year (AU 2018). A blue rose developed using genetic engineering is commercially available in Japan and North America (ISAAA 2014). APHIS reviewed and deregulated this rose variety in 2011. A chrysanthemum developed using genetic engineering, also modified for production of blue flowers, has been developed, although not yet available in commercial markets (Noda et al. 2017).

3.5.1.2 Petunia developed using genetic engineering – Market Impacts

In 1987, Meyer et al. (1987) developed a petunia containing the corn *A1* DFR gene, which produced brick red-colored flowers. S&G Seeds, an affiliate of the Dutch seed company Zaadunie, licensed the technology, and in 1995 reported creating petunias with stable gene expression—and vivid orange color—fit for commercial breeding (Servick 2017). Other companies and researchers have obtained USDA clearance to import petunias developed using genetic engineering or for field trials of petunias developed using genetic engineering, including a Florida field trial of petunias that had improved orange flower color as reported by Oud et al. (1995), however, the companies were never granted deregulated status for any petunia varieties developed using genetic engineering (COGEM 2017; Servick 2017).

The petunia lines generated by Meyer apparently found their way to petunia breeding programs (Servick 2017). During 2015 and 2016, bright orange-colored petunias were observed in flower boxes decorating the Helsinki railway station (Servick 2017). The cultivar at the Helsinki railways station was Bonnie Orange. Tests showed that this variety was developed using genetic engineering (Haselmair-Gosch et al. 2018). Additionally, these tests suggested the petunia was the same as that developed by Meyer et al. (1987). Distributors apparently imported or bred the flowers without realizing the plants were GE varieties. On May 2, 2017, the Germany-based horticultural firm Selecta Klemm informed APHIS that it had moved a GE orange petunia into the United States (Malakoff 2017). This led to testing by USDA of numerous petunia varieties, which confirmed this particular variety and several others were developed using genetic engineering and were regulated by APHIS under 7 CFR part 340. The flowers originally came from Africa, Asia, Central America, Europe, South America, and Australia (Malakoff 2017).

On May 16, 2017, APHIS announced to the public and industry that several varieties of petunias developed using genetic engineering had been imported into the United States and distributed interstate without proper APHIS authorization (Malakoff 2017). After discussions with the industry, the supply chain voluntarily stopped sale of the unauthorized varieties. Following APHIS' announcement that petunias developed using genetic engineering had entered the commercial market, the petunia industry sought guidance from APHIS on a number of topics. These topics included appropriate destruction methods of these petunias, laboratory testing to identify petunias developed using genetic engineering, and methods to facilitate the importation of petunias that were not developed with genetic engineering. APHIS worked with breeders and growers represented by the American Seed Trade Association (ASTA) and AmericanHort to ensure that all the implicated petunia varieties were withdrawn from distribution and destroyed. The petunia industry has voluntarily removed biotech petunias developed using genetic engineering from commerce, destroying at their discretion. Destruction methods include incinerating, autoclaving, double-bagging and disposal in a municipal landfill, and grinding of seed. In addition, the industry is proactively testing varieties to ensure additional unauthorized GE petunias are not imported into the United States or distributed interstate without proper authorization.

APHIS' compiled a list of 40 petunia varieties, containing a trait developed using genetic engineering, that have entered the U.S. market. These varieties require an APHIS permit for importation, interstate movement, or field testing.

APHIS is unaware of any studies that have quantified or even estimated the cost of introduction, and subsequent discovery and removal from the market of petunia varieties developed using genetic engineering. In the absence of such data, anecdotal reports suggest that, to date, economic impacts, costs to producers and consumers, have been limited. This is likely due in part to the myriad varieties of petunias on the market (colors, solid/variegated, growth habit).

A member of the Society of American Florists' Growers Council stated that the petunias developed using genetic engineering were not having a substantive impact on business because orange petunias (the varieties developed using genetic engineering) are not one of their major petunia colors (Westbrook 2017). The member further stated that they did have to destroy some petunias and are working on replacing them with other varieties, for example orange calibrachoa, but that there should be no effect on their customers (Westbrook 2017). At least one breeding company announced that their orange, red, and purple petunias were comprised of the *A1* DFR gene, but had withdrawn all of these from the market (Westbrook 2017). No costs of removal were reported. Another Growers Council member stated that although none of the affected varieties (hybrids developed using genetic engineering) were items they carried, they were, however, concerned that there still may be other varieties that will be found that were developed using genetic engineering (Westbrook 2017). The Growers Council Chairman estimates that petunias developed using genetic engineering constitute only a small fraction (about 1%) of all petunias in the marketplace (Westbrook 2017).

One option for growers to limit the cost of purchase and removal of varieties developed using genetic engineering is to temporarily raise the retail price on other varieties sold. As inventory shrinks, Dr. Bridget K. Behe, professor of horticultural marketing at Michigan State University, suggests that if there's a limited supply, the best way to help the flow of supply and demand is to temporarily increase the price (Simakis et al. 2017). Lastly, another factor that can ease a potential economic impact is that, given the plethora of color varieties in petunia developed without genetic engineering, there are other colored varieties that can be substituted, to choose from, as varieties developed using genetic engineering are pulled from the market (Simakis et al. 2017).

These factors considered, the industry is proactively testing varieties to ensure additional unauthorized petunias are not imported into the United States or distributed interstate without proper authorization. It follows, there is likely some nominal cost to industry for conducting testing of petunias.

3.5.2 International Trade

The Netherlands, the United States, and Japan are the three most important global producers and consumers of floricultural products (Xia et al. 2006; Wocial 2012). Floriculture products include four groups: cut flowers, cut foliage, potted plants (both flowers and greens), and bedding plants (Xia et al. 2006). The largest exporter of floriculture products during 2006–2011 is the Netherlands. However, emerging markets, particularly countries in South America (Colombia and Ecuador) and Africa (Kenya), have also claimed a significant portion of the export trade. During this same period, the majority of countries importing floriculture products were European, and non-European importers of significance included the United States, the Russian Federation, and Japan (Maleka et al. 2013). During the last two decades, U.S. imports have been increasing much faster than exports (ornamental plant seeds, cuttings, bulbs, plants, cut flowers, and foliage). In 1992, U.S. exports accounted for 29% of international trade in ornamental plant material, while imports accounted for 71%. Between 1992 and 2011, exports grew at an average annual rate of 3.6% and imports grew at an average annual rate of 5.7% (Wocial 2012). As a result, exports doubled during that period while imports tripled. In 2011, U.S. companies imported $1.6 billion and exported $0.45 billion worth of ornamental plant seeds, cuttings, bulbs, plants, cut flowers and foliage (Wocial 2012). U.S. floriculture imports from 1992 -2011 in dollar value have been dominated by cut flowers, while imports of other product categories (such as plants and rooted cuttings, bulbs, unrooted cuttings, and flower seeds) were valued at least one third less over this period (Wocial 2012). Petunias are not sold as cut flowers and so would represent a small part of the U.S. floriculture import or export market.

Among ornamentals, petunia plants and seeds are not significant export or import products. U.S. petunia seed exports declined significantly between 2007 and 2011, and accounted for less than 1% of seed exports in 2011. Exports of all other flower seeds grew at an annual rate of 6.7% between 2007 and 2011 (Wocial 2012).

4 ENVIRONMENTAL CONSEQUENCES

This chapter provides the scientific and analytical basis for the comparison of the alternatives studied in this document and an evaluation of the potential environmental consequences that could derive from the alternatives considered in this EA; denying the petition or issuing a determination of nonregulated status for A1-DFR petunias. Pursuant to CEQ regulations, this chapter provides evaluation of the potential direct and indirect impacts and their significance (40 CFR §1508.8). An *impact* would be any change, beneficial or adverse, from existing (baseline) conditions for the affected environment as described in Chapter 3. For purposes of this analysis, a *direct impact* is that which would derive from APHIS' decision to no longer regulate A1-DFR petunias without being mediated by another entity or result from any intermediate steps or processes. An *indirect impact* is that which would occur later in time or at another place, and those that involve the actions or decisions of other individuals, or natural processes. Indirect impacts may include economic growth effects (e.g., changes in commodity markets), changes in the pattern of land use, and effects on air and water quality as a result of horticultural production. When the effects of an action add to or interact with the effects of other action(s) at a particular place and over the reasonably foreseeable future, resulting environmental consequences would be considered *cumulative impacts*. Potential cumulative impacts and means to mitigate any adverse environmental impacts (40 CFR 1508.7) are discussed in Chapter 5. For a more complete description of direct, indirect, and cumulative impacts, see CEQ and EPA guidance (CEQ 1997; US-EPA 1999). Compliance of APHIS's decision on the petition with federal, state, and local requirements (40 CFR §1506.2(d)) is discussed in Chapter 7.

4.1 Commercial Petunia Production and Use

<u>No Action Alternative: Commercial Petunia Production and Use</u>

APHIS' continued regulation of A1-DFR petunias, which would preclude commercial distribution of this variety, would not alone alter the acreage and areas used for U.S. petunia production, nor the current practices and inputs used for the commercial production of petunia. Production of petunia is expected to continue as practiced today. Petunia varieties may continue to be screened for presence of the A1-DFR construct prior to importing petunia varieties into the United States or engaging in commercial petunia production in the United States. Consumers would not have A1-DFR petunias available for planting, but would still have hundreds of other colored varieties available to them.

<u>Preferred Alternative: Commercial Petunia Production</u>

A determination of nonregulated status for A1-DFR petunias is not expected to change the acreage, methods, and areas used for petunia seed and bedding plant production. The change in color in A1-DFR petunias does not cause changes in growth habit, temperature tolerances, nutritional requirements, or other factors that would alter where or how it can be grown compared to non-GE petunia varieties. A1-DFR petunias will provide additional color varieties of petunia and is expected to compete with other color varieties that are currently in production and offered for sale in the United States. Commercial production of petunia will continue to be dictated by the domestic and import floral market demands and choices made by consumers, not only for petunias, but for other flowers that serve similar ornamental purposes as potted plants, hanging baskets, and in flower beds.

4.2 Physical Environment

Commercial floriculture production is a high-intensity and high-input form of agriculture that is often concentrated in one area, and may involve intensive use of resources, such as land, water, and inputs such as fertilizers, soil media, irrigation, and pesticides (Dennis et al. 2010; Wainwright et al. 2014). Petunias raised in nurseries or by homeowners are then planted in the built environment. The intensive and non-sustainable use of resources can negatively impact the environment. Because of the relatively high per-unit value of petunia plants for transplanting ($9.62/flat - Table 3-2), extensive inputs may be economically justified in their production. Petunia production is also temporally intensive and timed to meet market demand such as for spring bedding plants in temperate regions.

4.2.1 Soil Quality

No Action Alternative: Soil Quality

Under the No Action Alternative, A1-DFR petunias would continue to be regulated by APHIS and current acreage and area used for petunia production would be expected to continue unchanged. Current availability and usage of petunia as well as growing practices and inputs used for commercial and production of petunia in the built environment would not change from those currently used. Therefore, impacts on soil quality are not expected to change.

Preferred Alternative: Soil Quality

The potential impacts on soil quality from production of A1-DFR petunias are not expected to differ from the No Action Alternative. A1-DFR petunias do not require different growing practices or inputs from other petunia varieties (Westhoff 2019). Consequently, cultivation of A1-DFR petunia, would present the same potential impacts to soil quality as petunia varieties not developed using genetic engineering currently produced.

4.2.2 Water Resources

No Action Alternative: Water Resources

Ornamental flower production can impact water quality through the use of pesticides, fertilizers, growth regulators, and soil management practices, and the run-off of these inputs from nurseries/greenhouses, and urban landscapes into adjacent water bodies. Leaching of agronomic inputs into groundwater is also a concern. Irrigation can strain groundwater resources.

Under the No Action Alternative, A1-DFR petunias would continue to be regulated by APHIS and current acreage and growing practices for petunia production would be expected to continue unchanged. The potential impacts of petunia production on water resources in the United States, and national and local programs to reduce non-point source contaminants in agricultural runoff, and runoff itself, would continue under current trends. Existing water use and water quality conditions would be expected to be unchanged.

Preferred Alternative: Water Resources

Because the agronomic practices and inputs utilized for production of A1-DFR petunias would be the same as those commonly used for other petunia varieties, the sources of potential impacts on water resources would not be expected to differ. A determination of nonregulated status for A1-DFR petunias is not expected to change the acreage, methods, timing, and areas used for petunia production. Consequently, APHIS does not expect there to be any substantive changes in pesticides or other pest control measures, or other agricultural inputs, which can present risks to water quality.

4.2.3 Air Quality

No Action Alternative: Air Quality

Under the No Action Alternative, A1-DFR petunias would continue to be regulated by APHIS and current impacts to air quality associated with petunia production practices would be expected to continue unchanged. The EPA and USDA efforts to reduce emissions, along with state and local efforts would likewise continue (US-EPA 2017a).

Preferred Alternative: Air Quality

A determination of nonregulated status for A1-DFR petunias would have no effect on emission sources associated with petunia cultivation. Because agronomic practices and inputs would remain unchanged, as well as acreage utilized for petunia production, no changes to emission sources (i.e., fossil fuel burning equipment) or quantities are expected.

4.3 Biological Resources

4.3.1 Soil Biota

No Action Alternative: Soil Biota

Soil biota are an integral ecosystem component that may provide and sustain critical ecological processes and play a key role in soil structure formation, decomposition of organic matter, toxin removal, nutrient cycling, and most biochemical soil processes (Garbeva et al. 2004; Parikh and James 2014). They also suppress soil-borne plant diseases and promote plant growth (Doran et al. 1996). The main factors affecting soil biota populations and diversity include soil and plant type, and horticultural practices such as pesticide and fertilizer application, and irrigation (Garbeva et al. 2004). Petunias are often grown in containers which limit impacts to soil biota. Under the No Action Alternative, A1-DFR petunias would continue to be regulated by APHIS, and current impacts to soil biota associated with petunia production practices (discussed in Section 3.3.1) would be expected to continue unchanged.

Preferred Alternative: Soil Biota

A determination of nonregulated status of A1-DFR petunias is not expected to result in any new impacts to soil biota. A1-DFR petunias are not expected to change the practices and inputs used in petunia production due to the inserted *A1 DFR* gene that confers the potential changes in petal color in A1-DFR petunias (Westhoff 2019).

The A1-DFR petunias express both the corn *A1 DFR* gene which allows for production of pelargonidin (Westhoff 2019), and the *nptII* gene and associated NPTII enzyme, which is needed for genetic selection. The *A1 DFR* gene, DFR enzyme, and pelargonidin occur naturally in some plants, and the *nptII* gene and associated NPTII enzyme are present in soil and aquatic bacteria and animal gastrointestinal flora (Smalla et al. 1993; Lopes-da-Silva et al. 2001; EFSA 2004; Welch et al. 2008; Maleka et al. 2013; Diretto et al. 2019). For petunias planted directly into soil, degradation of A1-DFR petunias' plant tissues would lead to the introduction of DFR and NPTII into soils. Putatively, these may also be transferred to soils via root exudates (Badri and Vivanco 2009), although to APHIS' knowledge the presence of these transgene products in root exudates has not been specifically studied in A1-DFR petunias. Because the genes and gene products inserted into A1-DFR petunias are already found in the environment, in natural soil constituents, it is unlikely that A1-DFR petunias present any new risk to soil biota. In addition, the area planted to petunias in flower gardens in the United States is a small percentage of the cultivated acreage in the United States as discussed in Section 3.1.2. Thus, the planting and degradation of A1-DFR petunias in areas where it is cultivated is unlikely to adversely affect soil biota. In general, it is the effects of normal horticultural/cultivation practices, such as fertilizer and pesticide use, which have greater impacts on soil communities (Smit et al. 2010) and these are not expected to be different under the Preferred Alternative.

4.3.2 Animal Communities

<u>No Action Alternative: Animal Communities</u>

As discussed in Section 3.3.2 a variety of animal and insect species feed on or use petunia. Mammals and birds may use petunias for food, or may feed on the insects feeding on petunias. Invertebrates can feed on petunia plants or prey upon other insects as well as using petunia for pollen and nectar sources. Under the No Action Alternative, A1-DFR petunias would continue to be regulated by APHIS and current impacts to animal communities associated with petunia production would be expected to continue unchanged. When used consistent with the EPA-registered uses and labels, pesticide applications used during petunia production present an acceptable level of risk to non-target animals.

<u>Preferred Alternative: Animal Communities</u>

Under the Preferred Alternative, potential impacts to animal communities are not anticipated to be different compared to the No Action Alternative. Potential impacts to animal communities arise from any changes in production practices associated A1-DFR petunias and direct exposure to A1-DFR petunias and its products.

A1-DFR petunias would not require any change to petunia production practices and therefore would have the same impacts to animal communities as the No Action Alternative. Petunia growers would continue to choose pesticides based on weed, insect, and disease pressures. Any pesticide used in cultivation of A1-DFR petunias must be used pursuant to EPA label requirements. The EPA evaluates the potential acute and chronic toxicity of a pesticide active ingredient via human health and environmental risks assessments. These assessment are conducted prior to a pesticide registration and inform EPA label use requirements (US-EPA 2019a). Adherence to the EPA pesticide label instruction is not only a legal requirement, it is fundamental to the safe use of the product. The EPA pesticide label instructions apply to anyone using a pesticide, commercial producer and home gardener alike. When used according to EPA label requirements, pesticides are considered to present an acceptable level of risk to non-target animals.

A1-DFR petunias were modified to increase production of pelargonidin by insertion of a *A1 DFR* gene derived from corn (Westhoff 2019). Corn is commonly consumed by animals with no known adverse effects. Pelargonidin, the anthocyanidin pigment produced in A1-DFR petunias via the DFR enzyme, is one the six most common anthocyanidins found in edible plants (e.g., red potatoes, strawberries, blueberries, raspberries) and is common in many horticultural plants (Lopes-da-Silva et al. 2001; Welch et al. 2008; Maleka et al. 2013; Diretto et al. 2019). None of these food, ornamental, or wild plants are known to pose unique environmental or animal health risks due to the presence of pelargonidin.

The *nptII* gene in A1-DFR petunias was derived from *Escherichia coli* bacteria*.* The *nptII* gene (and/or homologous sequences from other bacteria) occurs naturally in soil microbial communities, manure, and the normal intestinal flora of animals (Smalla et al. 1993; EFSA 2004), thus, animals are regularly exposed to the NPTII enzyme encoded by these genes. NPTII confers resistance to kanamycin, neomycin, and similar antibiotics (EFSA 2004). The *nptII* gene was inserted to function as a selectable marker in the initial stages for identifying modified cells during the genetic modification of A1-DFR petunias (Westhoff 2019). Various risk assessments have been conducted for NPTII (e.g., (Fuchs et al. 1993; EFSA 2004)); none have reported risks to wildlife or the environment as a result of exposure to or consumption of NPTII. The FDA reviewed and approved NPTII for use as an additive in various foods used for human consumption (US-FDA 1994). The EPA established an exemption for the requirement for an NPTII residue tolerance limit when NPTII is used as a ‘plant pesticide inert ingredient’ (US-EPA 1994). The *nptII* gene is present in many genetically modified plants approved for commercial release in the United States and other countries (Rosellini 2012).

DFR and associated pelargonidin and NPTII introduced into A1-DFR petunias presents negligible risk to wildlife, including the primary petunia pollinators hummingbird, bee, and hawk moth. The various colors and patterns expressed in A1-DFR petunias may visually attract or repel various vertebrates and invertebrates. The variety of nearby plants upon which animals can forage or pollinate will negate the effect of the new color variety on vertebrate or invertebrate species that use petunia. The other physical characteristics such as flower shape, plant structure, and chemical characteristics such as scent and nectar of A1-DFR petunias are not known to have been changed. Vertebrates and invertebrates, including pollinators that visit petunia would continue to visit A1-DFR petunias unless there was a preference for flowers of a different color. In unpublished observations submitted by the petitioner, A1-DFR petunias were observed to have similar seed set to that of non-GE petunia, indicating pollinators equally visited A1-DFR petunias (Westhoff 2019). The DFR enzyme introduced into the plant is active only in the petals of the flowers (Westhoff 2019). The impacts to pollinators is negligible because pollinators would have a wide range of plants in areas where petunias are likely planted on which to forage.

A1-DFR petunias serve as a host to the same range of plant pests as other petunia varieties. Varieties of petunia differ in their susceptibility to plant pests. The genetic modification in A1-DFR petunias do not change the plant's resistance or other natural defenses.

4.3.3 Plant Communities

No Action Alternative: Plant Communities

As discussed in Section 3.3.3 a variety of plant species are found in and around where petunia are grown. Unwanted vegetation in and around greenhouses used for petunia cultivation or in flower beds once transplanted are limited by weed control practices. Under the No Action Alternative, A1-DFR petunias would continue to be regulated by APHIS and potential impacts to plant communities associated with petunia production would be expected to continue unchanged. When used consistent with the EPA-registered uses and labels, pesticide applications used during petunia production present an acceptable level of risk to non-target plants.

Preferred Alternative: Plant Communities

Under the Preferred Alternative, potential impacts to plant communities are not anticipated to be different compared to the No Action Alternative.

A1-DFR petunias are not expected to change the practices and inputs used in petunia production due to the inserted *A1 DFR* gene that confers the various colored petals to A1-DFR petunias (Westhoff 2019).

A determination of nonregulated status for A1-DFR petunias would not be expected to affect the total acreage and area were petunia is cultivated nor the cultivation and management practices used for petunia. Consequently, any impact to plant communities as a result of petunia production under the Preferred Alternative would be the same as the No Action Alternative.

4.3.4 Gene Flow and Weediness

No Action Alternative: Gene Flow and Weediness

Under the No Action Alternative, A1-DFR petunias would continue to be regulated by APHIS. Conventional petunias would continue to be produced and widely available for use as a bedding plant. As described in Section 3.3.4, gene flow is a biological process that facilitates the production of hybrid plants, introgression of novel alleles, and evolution of new plant genotypes. For petunia, both animal-mediated cross pollination (e.g. by bees, moths, or hummingbirds) and natural seed dispersal can result in gene movement mostly within a local population, while intentional distribution and propagation (via seed or vegetative cuttings) promote the movement of genes across time and larger landscapes. While dispersal of the transgenes by pollen-mediated gene flow is possible to other species in the genus *Petunia* (with 14 chromosomes), it is important to note that petunia does not cross with other genera. Additionally, hybrids of closely related *Petunia* species are rare in nature (Jędrzejuk et al. 2017). Under the No Action Alternative, A1-DFR petunias would not be available to consumers and would not be grown outdoors without an APHIS issued permit with specific conditions to limit the likelihood of gene flow from A1-DFR petunias and the persistence of the A1-DFR petunias or its progeny in the environment. Furthermore, interstate movement and importation of A1-DFR petunia plants or viable propagules would also require an approved permit or notification from APHIS with conditions to prevent unauthorized introductions or persistence.

While there are naturalized *Petunia* species in the United States, there no plants among the *Petunia* genera on the Federal noxious weed list nor are they listed as invasive by any state (USDA-NRCS 2019c). Petunia does not spread vegetatively, i.e. the plant does not produce organs such as stolons, rhizomes, root borne shoots, tubers, corms, or runners. Roots will not form on discarded parts of a plant under outdoor conditions (Westhoff 2019). Little evidence exists to suggest that petunia behaves as a weed. Weediness potential associated with petunia production is not expected to change under the No Action Alternative.

Preferred Alternative: Gene Flow and Weediness

Potential concerns related to gene flow and weediness related to A1-DFR petunias are the transfer of the introduced trait gene (e.g., flower color) to sexually compatible species through hybridization, introgression of the trait genes into populations of sexually compatible relatives, and naturalization of A1-DFR petunias and/or hybrids. Some people may have concerns regarding the impacts of the A1-DFR petunias trait genes on naturalized *Calibrachoa* and *Petunia* populations in the United States, if gene flow were to occur. There may also be some concern regarding the potential for gene flow among A1-DFR petunias and other garden petunia populations in the built environment (i.e., those planted as ornamentals around homes or businesses or botanical gardens), and concerns that A1-DFR petunias may escape from areas and cultivation and form naturalized populations, or become weedy. Incorporation of the color trait genes into populations of sexually compatible species via hybridization, and particularly introgression, could present an ecological concern, as well as an economic concern to producers and retailers of the petunia.

A1-DFR petunias have been modified for a change in flower color only (with the exception of the *nptII* gene). The change in color in A1-DFR petunias does not cause changes in seed set, pollen availability, growth habit, temperature tolerances, nutritional requirements, or other factors that would alter where it can be grown or the potential for cross pollinating compared to currently available petunia varieties. The physical and biological processes and mechanisms by which pollen-mediated gene flow occurs is not unique or different for A1-DFR petunias; the likelihood of occurrence of pollen mediated gene flow among all petunia plants and sexually compatible wild relative species is the same as under the No Action Alternative.

A1-DFR petunias form viable pollen and therefore movement of the transgenes into sexually compatible non-GE species by pollen-mediated gene flow is possible (Westhoff 2019; USDA-APHIS 2020). Most petunia plants set seed easily. Very few varieties exhibit limited fertility or sterility. The rate and success of pollen mediated flow is dependent on various factors such as the:

- presence, abundance, and distance of sexually-compatible plant species;
- overlap of flowering times among populations;
- pollinator species;
- biology and amount of pollen produced; and,
- weather conditions, including temperature, wind, and humidity.

Petunia species are pollinated by bees, hawk moths, or hummingbirds, and which pollinator type relates to flower shape, color, aroma, petal UV properties, and nectar access and/or composition (Ando et al. 2001; Rodrigues et al. 2018). Pollinators of *Petunia* are divided into four functional groups according to Fenster et al. (2004): long-tongued bees, short-tongued bees, hummingbirds, and hawk moths. *Petunia* species show relationships with certain pollinator groups: *P. secreta* (bee-adapted), *P. axillaris* (moth-adapted), *P. exserta* (hummingbird-adapted), and *P. integrifolia* (bee-adapted) (Sheehan et al. 2012; Rodrigues et al. 2018).

Due to its morphology, and its parental lines of *P. axillaris x P. integrifolia*, it is expected that *Petunia* x *hybrida* will predominantly be pollinated by bees and hawk moths, and to a lesser extent hummingbirds (Ando et al. 2001; Sheehan et al. 2012). For the purpose of this EA it is assumed that A1-DFR petunias may be pollinated by all three.

When hawk moth pollinated, long distance pollen dispersal (up to 1,013 meters) is possible as studied in *P. axillaris* subsp. *axillaris*, but in this study a high proportion of self-pollination was found and most pollen dispersal (96%) occurred at distances of less than 1 m, with cross-pollination occurring mostly within patches (Turchetto et al. 2015). Hawk moths occur nationwide (Bartlett et al. 2019). Most reports are in the range of 10 km as a maximum distance for a bee foraging flight, and most bees will be found within 6 km of their hive or nest (e.g., (Beekman and Ratnieks 2000; Pasquet et al. 2008; Castilla et al. 2017)). In studies with various plant species, large bees like bumble bees are reported to forage at distances of around 6 km or more from the nest (Pasquet et al. 2008); medium-sized bees such as mining bees (*Andrena* spp.) or leafcutter bees (*Megachile* spp.) forage within 350–450 m from the nest; and small bees, such as sweat bees (*Halictus* spp.) and small carpenter bees (*Ceratina* spp.) generally forage within 200 m from their nest (AAFC 2014). But results by Castilla et al. (2017) show that, small-bodied bees were responsible for more than 49% of pollen dispersal events beyond 1 km. Thus, bees can potentially transfer pollen up to around 10 km.

Bird pollinators can cover much greater distances than insect pollinators, increasing gene flow between plant populations and preventing the fragmentation of populations that drives speciation (Abrahamczyk and Renner 2015). Many hummingbirds pollinate several related plant species; for example, the North American ruby-throated hummingbird (*Archilochus colubris*) is known to pollinate three different species of the Silene genus (Abrahamczyk and Renner 2015). The Ruby-throated Hummingbird habitat overlaps that of naturalized *P. hybrida* in the United States (USDA-NRCS 1999). A hungry hummingbird might visit between 1,000 and 3,000 flowers a day to maintain an adequate caloric intake (Almond 2018).

While hummingbirds can travel long distances, the percentage of flowers visited by hummingbirds is localized to the environment in which the bird is foraging, and exponentially declines with distance from the flower visited, especially if the flowers are within the territory of a male hummingbird (Linhart 1973; Linhart 2014).

Considering the pollination schemes and distances pollinators may travel, gene flow from A1-DFR petunias to cultivated and naturalized petunia species is possible, with gene flow to petunia planted in the built environment in proximity to A1-DFR petunias more likely than to naturalized petunias which are rare. While dispersal of the transgenes by pollen-mediated gene flow is possible, it is important to note that petunia does not cross with other genera. Petunia and

Calibrachoa, the most closely related genus, does not form interspecific hybrids in nature or after artificial pollination (Wijsman 1983; Jędrzejuk et al. 2017). Species of Petunia and Calibrachoa often grow together throughout their natural range, but no hybrid individuals have been found (Ando et al. 2001). In fact, hybrids of closely related Petunia species are rare in nature (Jędrzejuk et al. 2017). Therefore, under the Preferred Alternative, the likelihood of gene flow from A1-DFR petunias is no different than the levels of gene flow from current petunia varieties.

Weediness potential could be affected if seed dormancy and germination characteristics change. The change in color in A1-DFR petunias does not cause changes in seed set, growth habit, temperature tolerances, or other factors that would alter where it can be grown or the potential for weediness compared to currently available petunia varieties (Westhoff 2019; USDA-APHIS 2020). Petunia is not listed as a weed in major weed references, nor is it present on the lists of noxious weed species distributed by the federal government (USDA-NRCS 2019c).

Petunias are a perennial plant in its native range, but are generally grown as an annual ornamental plant in home gardens. While petunias can be perennials in USDA zones 9 to 11, they are not frost tolerant and do not survive freezing winter conditions. In warmer climates such as southern Florida and Arizona they are grown as winter annuals, from fall to spring (UF-IFAS 2014; Kopcinski 2019). While typically grown as an ornamental bedding plant, several species in the *Petunia* genus are considered naturalized in the United States (Figure 3-1) (USDA-NRCS 2019b).

There is no evidence, nor reason to assume in the absence of evidence, that the introduced trait (altered flower color) in A1-DFR petunias (*Petunia* x *hybrida*) alters its fitness, confers weediness characteristics, or presents risks to petunia and other plant communities. Field studies with A1-DFR petunias have shown that there are no significant differences in heat or cold tolerance, disease and insect susceptibility, nor any apparent difference in the attractiveness of A1-DFR petunia flowers (pollen, nectar) to pollinators (Westhoff 2019). Outdoor trials in 2016 and 2017 by Ohio State University, Colorado State University, and Horticultural trial station Bad Zwischenahn (Germany) showed no difference between non-GE petunia and A1-DFR petunias for all traits studied (Westhoff 2019).

Based on the biological activity of the introduced *A1 DFR* gene and enzyme product conferring pigment expression, and the potential for hybridization and naturalization, A1-DFR petunias would present negligible risks to the viability or fitness of plants of the *Petunia* or *Calibrachoa*, genera. There are no environmental nor plant-based risks associated with flower color derived from pelargonidin, although flower color is known to play a part in pollinator preference for flowers. The introduced *A1 DFR* and *nptII* genes do not confer any weedy characteristics to A1-DFR petunias; they confer only flower color via the *A1* DFR gene and antibiotic resistance marker trait via *nptII*. Thus, if gene transfer to related *Petunia* or *Calibrachoa*, species occurred, these genes would not be expected to confer any toxic, allergenic, or weedy characteristics to recipient species.

The DFR GE trait has been detected in 124 petunia varieties (USDA-APHIS 2017). While these GE petunias contain a *DFR* gene, not all contain the *A1 DFR* gene from corn. Over a million orange petunias (presumed to be GE petunia varieties) have been sold over the last 15 years (COGEM 2017); APHIS is unaware of any reports of GE petunia populations that have formed naturalized populations, or adversely impacted naturalized populations. APHIS is unaware of any reports of GE petunia populations adversely impacting the built environment.

4.3.5 Biodiversity

No Action Alternative: Biodiversity

Biological diversity, or the variation in species or life forms in an area, is highly managed in greenhouse production systems. In petunia production, growers want to encourage high yields, and will intensively manage plant and animal communities through chemical and cultural controls to protect the crop from damage. As an ornamental plant grown in beds, pots, and hanging baskets, petunia largely relates to biodiversity within the built environment. In urban and suburban environments, non-native horticultural or ornamental plants can serve as an important food source for pollinators.

Under the No Action Alternative, A1-DFR petunias would continue to be regulated. Growers, landowners, and landscape managers would continue to have access to conventional petunia varieties. The availability of petunia as a pollen and nectar source in the built environment, will not change under the No Action Alternative. Impacts to biodiversity associated with cultivating petunias is not expected to change under the No Action Alternative. Animal and plant species that typically inhabit petunia production areas will continue to be affected by currently used production practices.

Preferred Alternative: Biodiversity

A1-DFR petunias would not be expected to change growing practices, and therefore would not likely impact biodiversity any differently than conventional petunia. Other than the availability of an additional color there are no differences between A1-DFR petunias and conventional petunia varieties. The *A1 DFR* gene and subsequent production of pelargonidin is unlikely to present risks to plant, animal, fungal, or bacterial communities as it commonly occurs in several food plants including strawberry (Lopes-da-Silva et al. 2001) and other flowering horticultural species such as Pelargonium, dahlia, verbena, morning glory, and hyacinth (Diretto et al. 2019). Based on this information, APHIS has determined that approval of a petition for nonregulated status of A1-DFR petunias will have the same impact on biodiversity as the No Action Alternative.

4.4 Human Health and Worker Safety

No Action Alternative: Human Health and Worker Safety

Under the No Action Alternative, A1-DFR petunias would continue to be regulated by APHIS. Current availability and usage of petunia is expected to remain the same under the No Action Alternative. As noted in Section 3.4 – Human Health, petunias are not a food and not consumed by humans or used for animal feed. Exposure to pesticides used on petunia would continue under the No Action Alternative. Management practices for petunia production, and the associated human health impacts, are expected to continue under the No Action Alternative. Worker safety is taken into consideration by the EPA in the pesticide registration and registration review processes. When use is consistent with the label, pesticides present minimal risks to workers.

Preferred Alternative: Human Health and Worker Safety

Under the Preferred Alternative, potential impacts to human health are not anticipated to be different from those under the No Action Alternative. Petunia is not consumed by humans and is not used as animal feed.

The potential human health impacts associated with pesticide use for the production of A1-DFR petunias under the Preferred Alternative would be the same as under the No Action Alternative as production practices will not change. The EPA WPS will continue to provide the same level of protection as is currently available under the No Action Alternative. Accordingly, impacts to worker health under the preferred Alternative are expected to be the same as the No Action Alternative.

4.5 Socioeconomics

4.5.1 Domestic Economic Environment

No Action Alternative: Domestic Economic Environment

Under the No Action Alternative, A1-DFR petunias would continue to be regulated by APHIS. Non-GE petunia production and use is expected to continue much as it is currently. Denial of the petition would have negligible impact on the U.S. domestic petunia market.

Preferred Alternative: Domestic Economic Environment

A determination of nonregulated status for A1-DFR petunias is not expected to have a large impact on the petunia market. A1-DFR petunias would provide novel colored flowers, which is likely desired as over a million orange petunias (presumed to be GE petunia varieties) have been sold over the last 15 years (COGEM 2017). A1-DFR petunias may also be used to produce hybrids with other novel flower colors. Petunia are continually bred for new flower color/pattern, as well as plant hardiness, shape, and growth habit. Due to the novel flower color, A1-DFR petunias and/or hybrids may take market share from other petunia varieties, as well as other ornamental plants. However, this additional color variety is not expected to result in a significant increase in petunia demand or production in the United States; A1-DFR petunias will add additional color varieties to the hundred or more varieties of petunia currently available to the U.S. market. A1-DFR petunias will compete for market share among a diverse array of petunia varieties currently in commerce. Wholesalers/producers would be expected to choose to cultivate and retailers choose to sell A1-DFR petunias relative to customer demand for the product. Additionally, those developers who inadvertently bred A1-DFR into their petunia lines will have an opportunity to recoup their return on investment in developing those varieties by being able to sell those varieties.

GE Ornamentals

While petunia is one of the more popular ornamental flowers, and novelty in color and other attributes are valued in petunia, consumer preference for a GE petunia is uncertain (Anderson and Walker 2013). A1-DFR petunias (or hybrids produced from A1-DFR petunias) were produced and sold in the United States, without the proper authorizations, for about 15 years (up until 2017). During this time most, if not all consumers, were unaware the petunias were produced through genetic engineering. The petitioner only propagates petunia by cuttings, not seed, and sends those vegetatively propagated petunias offshore for further vegetative propagation where flats of petunias are produced for distribution to local nurseries (Mehring-Lemper 2020). Additionally, the petitioner uses barcoded tracking for disease traceability and plans to label A1-DFR petunias with a logo or symbol indicating to producers that they were developed using genetic engineering (Mehring-Lemper 2020). Through vegetative propagation, tracking and tracing, and labelling, the chance that the A1-DFR trait will be bred into petunias intended for a biotech-sensitive market is expected to be lessened.

There is no requirement, in the United States, for labeling of a flower as developed using genetic engineering (USDA-AMS 2018) (other countries have different requirements). However, given the press reports and USDA's website that list petunia varieties developed using genetic engineering (USDA-APHIS 2017), consumers could be aware that A1-DFR petunias are developed using genetic engineering and choose to avoid them at their discretion.

Unlike the No Action Alternative where A1-DFR petunia is not marketable, there will be markets for these petunias under the Preferred Alternative. In the unlikely event that A1-DFR is found in other petunia varieties, the socioeconomic impacts are potentially less than under the No Action Alternative.

4.5.2 International trade

No Action Alternative: Trade Economic Environment

Among ornamentals, petunia plants and seeds are not significant export or import products. While U.S. exports of other flower seeds grew at an annual rate of 6.7% between 2007 and 2011, petunia seed exports declined and accounted for less than 1% of seed exports in 2011 (Wocial 2012). Because petunias represent such a small portion of the horticultural trade industry the current availability and use of commercially cultivated biotech and non-biotech petunia, and trade of these commodities, would be unaffected by denial of the petition.

Preferred Alternative: Trade Economic Environment

International trade is facilitated by the World Trade Organization (WTO) and the Organization for Economic Cooperation and Development (OECD) (OECD 2019; WTO 2019a). Standards and guidelines for the safety evaluation and trade of GE commodities are established under international policy and agreements such as the Codex Alimentarius (for food) (FAO 2009), the WTO International Plant Protection Convention (plants) (WTO 2019b), WTO Sanitary and Phytosanitary Measures (food safety, and animal and plant health) (WTO 2019a), WTO Technical Barriers to Trade Agreement (WTO 2019c), and the Cartagena Protocol on Biosafety (all organisms modified or produced using biotechnology) (CBD 2012). Goods imported into a given country must meet that country's established sanitary and phytosanitary requirements. For example, if you export plants and plant products to the European Union (EU), you must ensure that the products comply with EU legislation on plant health. Likewise, seeds and plant propagating material, to include ornamental plants, must comply with specific marketing requirements to ensure plant health and quality.

A1-DFR petunias would be subject to the same international regulatory requirements, discussed above, as currently traded flower varieties. In general, developers have various legal, quality control, and marketing motivations to implement rigorous stewardship measures to ensure identity preservation, and compliance with international agreements and standards. By necessity, all international regulatory and industry standards and requirements must be met for marketing of A1-DFR petunias. The petitioner and their producers only propagate petunia by cuttings and will not be shipping any seed (Mehring-Lemper 2020). Additionally, the petitioner uses tracking and tracing in their supply chain and plans to label A1-DFR petunias with a logo or symbol to alert its producers that the A1-DFR petunias were developed using genetic engineering (Mehring-Lemper 2020).

It is easier to identify preserve plant material than seeds based on the size of the material, the tracking and tracing employed, and the morphological characteristics of the plant. If commingling of petunia developed with and without genetic engineering were to occur, it is more likely to occur in the seed than in barcoded plant material. Considering the above factors and the small amount of petunia seed exports, the international socioeconomic impacts under the Preferred Alternative are not expected to be significantly greater than under the No Action Alternative.

5 POTENTIAL CUMULATIVE IMPACTS

A cumulative impact may be an effect on the environment which results from the incremental impact of the proposed action when added to other past, present, and reasonably foreseeable future actions.

5.1 Assumptions and Uncertainties

Cumulative impacts have been analyzed for each environmental issue assessed in Chapter 4, Environmental Consequences. In this EA, the cumulative impacts analysis is focused on the incremental impacts of the Preferred Alternative taken in consideration with related activities including past, present, and reasonably foreseeable future actions. In this analysis, if there are no direct or indirect (i.e., removed in time or place) impacts identified for a resource area discussed in Chapter 4, then APHIS assumes there can be no cumulative impacts. Where it is not possible to quantify impacts, APHIS provides a qualitative assessment of potential cumulative impacts.

If APHIS determines that A1-DFR petunias are no longer regulated it is assumed that A1-DFR petunias will be grown in similar ways and locations as other varieties of petunia, and that both the plant and seed will be commercially marketed in the United States and abroad. A1-DFR petunias could also be combined with other GE and non-GE varieties through traditional breeding techniques. For example, A1-DFR petunias could be crossbred with grandiflora, multiflora, milliflora, and spreading or ground cover varieties expanding the range of flower colors available in those varieties. The adoption of A1-DFR petunias and progeny would depend on the extent to which consumers valued the colors A1-DFR petunias offered, relative to other petunia varieties. It would also depend on whether consumers were opposed to a GE petunia, or unconcerned that a petunia were GE.

There are a wide range of benefits associated with the development of new plant varieties (UPOV 2019), and the genetic engineering of ornamentals for flower color, floral anatomy and morphology, fragrance, and abiotic and biotic stress tolerance is an active area of research (see (Dobres 2008; Nishihara and Nakatsuka 2010; Noman et al. 2017)). Additional types of GE flowers, and those modified via genome editing (Kishi-Kaboshi et al. 2018), may become commercially available. However, there are economic barriers to the development and commercialization of certain GE ornamental plants, thus, introduction of new GE varieties is likely to be incremental (Dobres 2008). For example, as analyzed in Dobres (2008), a total of 164 permits for movement and introduction on non-grass GE ornamental plants were issued by APHIS from 1989-2006, but only one product (GE violet carnations) was commercialized during this time period (Dobres 2008). Therefore, APHIS cannot reasonably foresee the number or types of ornamental plants, developed via methods of biotechnology, which may become available and grown.

5.2 Cumulative Impacts: Acreage and Areas of Petunia Production

There are no cumulative impacts on the areas or acreage utilized for petunia production that would derive from a determination of nonregulated status for A1-DFR petunias. The availability of A1-DFR petunias would provide additional color choices to consumers (salmon hued flower), and is expected to be purchased in the stead of other color varieties that are currently being grown and sold. As discussed for Assumptions and Uncertainties, it is likely that, over time, additional flowering plants with novel color variations and other traits such as disease resistance will be developed, via biotechnology methods, and sold (Dobres 2008; Noman et al. 2017; Kishi-Kaboshi et al. 2018). These varieties with novel traits are expected to replace some of those that are currently grown and sold; it is unlikely there would be a substantial increase in resources (i.e., acreage and crop inputs) used for production of these varieties.

5.3 Cumulative Impacts: Physical Environment

As discussed in Chapter 4, a determination of nonregulated status for A1-DFR petunias under the Preferred Alternative would have the same potential impacts to water, soil, and air quality as that of conventional petunia varieties currently available. The horticultural practices that have the potential to impact soil, water and air quality, such as inputs (fertilizers and pesticides) and irrigation used in the cultivation of A1-DFR petunias, and environmental interactions, are no different than that of currently available petunia varieties. A determination of nonregulated status for A1-DFR petunias and its subsequent commercial production, would not change the agronomic practices and inputs used for petunia production. Therefore, no cumulative impacts to the physical environment would be expected.

5.4 Cumulative Impacts: Biological Resources

As discussed in Chapter 4, a determination of nonregulated status for A1-DFR petunias would have no direct or indirect impacts to the biological environment. No cumulative impacts on soil biota, animal or plant communities, or biodiversity are associated with the cultivation and marketing of A1-DFR petunias that differ from production of current petunia varieties. The change in color in A1-DFR petunias is unlikely to present any risk to wildlife, to include plant pests. Exposure to A1-DFR petunias is unlikely to impact organisms as the *A1 DFR* gene, DFR enzyme, and pelargonidin pigment naturally occur in some plants including many common food plants and the nptII gene and associated NPTII enzyme are present in soil and aquatic bacteria and animal gastrointestinal flora and expressed in many transgenic deregulated plant varieties, and none of these have been noted as having adverse effects associated with consumption. Because the horticultural practices and inputs for A1-DFR petunias are the same as for other petunia varieties, a determination of nonregulated status of A1-DFR petunias would not present any novel risks to biological resources with respect to chemical inputs.

If A1-DFR petunias are increasingly planted over the years, in combination with plantings of existing and newly developed petunia varieties (e.g., urban and suburban environments), it is likely it will cross-pollinate with other *Petunia* species in proximity that share the same pollinator(s). Thus, movement of A1-DFR petunias and A1-DFR petunia hybrids transgenes into other nearby garden/ornamental petunia plants is possible. While dispersal of the transgenes by pollen-mediated gene flow is possible, it is important to note that petunia does not cross with other genera. *Petunia* and *Calibrachoa*, the most closely related genus, does not form interspecific hybrids in nature or after artificial pollination (Wijsman 1983; Jędrzejuk et al. 2017). In fact, hybrids of closely related *Petunia* species are rare in nature (Jędrzejuk et al. 2017). So while movement of A1-DFR petunias transgenes into current *Petunia* populations is possible, it is considered an unlikely event as A1-DFR petunias are expected to be most commonly planted as an annual ornamental in highly managed rural, suburban, and urban environments (e.g., residential and commercial properties). Additionally, petunia volunteers or self-seeding is rare. Therefore, the likelihood of gene flow from A1-DFR petunias is no different than the levels of gene flow from current petunia varieties.

The change in color in A1-DFR petunias does not cause changes in seed set, pollen availability, growth habit, temperature tolerances, or other factors that would alter where it can be grown or the potential for weediness compared to currently available petunia varieties (Westhoff 2019; USDA-APHIS 2020). There is no evidence, nor reason to assume in the absence of evidence, that the introduced trait (altered flower color) in A1-DFR petunias (*Petunia* x *hybrida*) alters its fitness, confers weediness characteristics, or presents risks to petunia and other plant communities. Cultivation of A1-DFR petunias would not be expected to directly, indirectly, or cumulatively impact biological resources any differently than cultivation of current petunia varieties.

5.5 Cumulative Impacts: Human Health

As discussed in Chapter 4, petunia is not consumed by humans and is not used as animal feed. The potential human health impacts associated with pesticide use would be unchanged from the No Action Alternative as A1-DFR petunias would not change the horticultural practices and inputs used for petunia production. The EPA WPS will continue to provide the same level of protection as is currently available under the No Action Alternative. No direct or indirect impacts on human health were identified. Consequently, there are no potential cumulative impacts.

5.6 Cumulative Impacts: Socioeconomics

As discussed in Chapter 4, no significant direct or indirect impacts on the domestic or international petunia markets were identified with commercialization of A1-DFR petunias. A1-DFR petunias are not likely to commingle with other petunia varieties as the petitioner does not ship seeds, propagates plants vegetatively, uses a barcoding system to track and trace individual plants, and plans to label plants as developed using genetic engineering (Mehring-Lemper 2020). Consequently, no cumulative socioeconomic impacts are expected from a determination of nonregulated status for A1-DFR petunias.

6 THREATENED AND ENDANGERED SPECIES

The Endangered Species Act (ESA) of 1973, as amended, is a far-reaching wildlife conservation law. The purpose of the ESA is to prevent extinctions of fish, wildlife, and plant species by conserving endangered and threatened species and the ecosystems upon which they depend. To implement the ESA, the U.S. Fish and Wildlife Service (USFWS) works in cooperation with the National Marine Fisheries Service (NMFS), together "the Services," as well as other Federal, State, and local agencies, Tribes, non-governmental organizations, and private citizens.

Before a plant or animal species can receive protection under the ESA, it must be added to the federal list of threatened and endangered wildlife and plants. Threatened and endangered (T& E) species are those plants and animals at risk of becoming extinct throughout all or part of their geographic range (endangered species) or species likely to become endangered in the foreseeable future throughout all or a significant portion of their ranges (threatened species).

The Services add a species to the list when they determine the species to be endangered or threatened because of any of the following factors:

- The present or threatened destruction, modification, or curtailment of its habitat or range;
- Overutilization for commercial, recreational, scientific, or educational purposes;
- Disease or predation;
- The inadequacy of existing regulatory mechanisms; or
- The natural or manmade factors affecting its survival.

Once a species is added to the list, protective measures apply to the species and its habitat. These measures include protection from adverse effects of federal activities.

6.1 Requirements for Federal Agencies

Section 7(a)(2) of the ESA requires that federal agencies, in consultation with the USFWS and/or the NMFS, ensure that any action they authorize, fund, or carry out is "not likely to jeopardize the continued existence of a listed species or result in the destruction or adverse modification of designated critical habitat." It is the responsibility of the federal agency taking the action to assess the effects of their action and to consult with the USFWS and NMFS if it is determined that the action "may affect" listed species or designated critical habitat (a process is known as a Section 7 Consultation).

To facilitate the development of its ESA consultation requirements, APHIS met with the USFWS from 1999 to 2003 to discuss factors relevant to APHIS' regulatory authority and effects analysis for petitions that request determination of nonregulated status of GE crop lines. By working with USFWS, APHIS developed a process for conducting an effects determination consistent with the Plant Protection Act (PPA) of 2000 (Title IV of Public Law 106-224). APHIS uses this process to help fulfill its obligations under Section 7 of the ESA for biotechnology regulatory actions.

If, after completing a Plant Pest Risk Assessment (PPRA), APHIS determines that A1-DFR petunias seeds, plants, or parts thereof do not pose a plant pest risk, then they would no longer be subject to the plant pest provisions of the PPA or to the regulatory requirements of 7 CFR part 340 and therefore APHIS would not have jurisdiction over A1-DFR petunias and can no longer regulate them. As part of developing its EA, APHIS analyzed the potential effects of A1-DFR petunias on the environment, including any potential effects to T&E species and/or critical habitat. As part of this process, APHIS thoroughly reviews GE product information and data related to the GE organism to inform the ESA effects analysis and, if necessary, the biological assessment. For each transgenic plant that APHIS receives a petition to no longer regulate, APHIS considers the following:

- A review of the biology, taxonomy, and weediness potential of the crop plant and its sexually compatible relatives;
- Characterization of each transgene with respect to its structure and function and the nature of the organism from which it was obtained;
- A determination of where the new transgene and its products (if any) are produced in the plant and their quantity;
- A review of the agronomic performance of the plant including disease and pest susceptibilities, weediness potential, and agronomic and environmental impact;
- Determination of the concentrations of known plant toxicants (if any are known in the plant);
- Analysis to determine if the transgenic plant is sexually compatible with any T&E species of plants or a host of any T&E species; and
- Any other information that may inform the potential for an organism to pose a plant pest risk.

As described below, in following this review process, APHIS has evaluated the potential effects that a determination of nonregulated status for A1-DFR petunias may have, if any, on federally-listed T&E species and species proposed for listing, as well as designated critical habitat and habitat proposed for designation.

6.2 Potential Effects of A1-DFR Petunias on T&E Species and Critical Habitat

As described in further detail elsewhere in this EA, in the petition (Westhoff 2019), and in the PPRA (USDA-APHIS 2020), Westhoff engineered A1-DFR petunia to synthesize pelargonidin and exhibit novel flower color possibilities, as well as to express a commonly used selectable marker (NPTII). APHIS considered the potential for A1-DFR petunias to extend the range of production, alter production practices, and also the potential to extend production or consumer use into additional areas. As discussed in 4.1 – Commercial Petunia Production, production of A1-DFR petunias is not expected to differ from non-GE petunia in methods, acreage, or geographic range. Westhoff reported that horticultural characteristics and cultivation practices required for A1-DFR petunias are essentially indistinguishable from practices used to grow other petunia varieties. A1-DFR petunias do not differ from non-GE petunia in growth habit, temperature or nutritional requirements or other physical conditions related to growth and survival (Westhoff 2019; USDA-APHIS 2020). Production and consumer use of A1-DFR petunias would then likely differ from non-GE petunia as a function of consumer preferences and market responses. Although A1-DFR petunias may replace certain other varieties of petunia that are currently cultivated, APHIS does not expect the introduction of GE petunia to result in new petunia acreage to be planted in areas that are not already devoted to ornamental horticultural uses.

The issues discussed herein focus on the potential environmental consequences that a determination of nonregulated status for petunia would have on T&E species in the areas where petunia are currently grown, which would potentially include all parts of the United States and its territories. Based upon the scope of the EA and production areas identified in the Affected Environment (Chapter 3) of this EA, APHIS reviewed the USFWS list of T&E species (both listed and proposed for listing) for the entire United States (USFWS 2020). Because this list can change, APHIS continually monitors changes in the status of T&E species, critical habitats, and other relevant actions by USFWS and NMFS.

For its analysis on T&E plants and critical habitat, APHIS focused on: the horticultural differences between GE petunia and petunia varieties currently grown; the potential for increased weediness; and the potential for gene movement to native plants, listed species, and species proposed for listing.

For its analysis of effects on T&E animals, APHIS focused on the implications of exposure to the plants developed using genetic engineering that result from the transformation of petunia as well as the ability of the plants developed using genetic engineering to serve as a host for a T&E species.

6.2.1 Threatened and Endangered Plant Species and Critical Habitat

Based on agronomic field data, literature surveyed on petunia weediness potential, and lack of sexually compatible T&E species with petunia (discussed in detail in Section 3.3.4 - Gene Flow and Weediness), APHIS has concluded that A1-DFR petunias will have no effect on T&E plant species or on critical habitat.

6.2.2 Threatened and Endangered Animal Species

Because there is no difference in toxicity or allergenicity potential between transgenic A1-DFR petunias and conventional non-GE petunias (as discussed in Section 4.3.4 - Gene Flow and Weediness), there would be no direct or indirect toxicity or allergenicity response by T&E animal species that come into contact (including feeding on) petunia or the associated biological food chain of organisms if A1-DFR petunias were no longer regulated. Consumption of A1-DFR petunia plant parts (seeds, leaves, petal, stems, pollen, or roots) by T&E animal species is unlikely and no toxic effect or allergenic response would be expected in excess of that associated with petunia currently present in the environment. APHIS considered potential exposure and/or consumption of A1-DFR petunias and concluded that, while there is a chance of incidental exposure, it is not likely that this would produce an appreciable response and there would not be any adverse effects on any listed threatened or endangered animal species or animal species proposed for listing nor would there be any adverse modification of critical habitat of any T&E species.

APHIS considered the possibility that A1-DFR petunias could be utilized (e.g. serve as a host plant) by threatened or endangered species (i.e., a listed insect or other organism that may use the petunia plant to complete its lifecycle). Pollinators of *Petunia* spp. include bees, hummingbirds, and hawkmoths (Rodrigues et al. 2018). A review of the T&E species list showed that federally listed (or candidate) T&E species in known pollinator taxa include the rusty patched bumblebee (*Bombus affinis*), Kern primrose sphinx moth (*Euproserpinus euterpe*), and Blackburn's sphinx moth (*Manduca blackburni*). Petunias are not considered weedy or invasive in the United States and the A1-DFR petunias did not have new characteristics that would increase weediness (USDA-APHIS 2020), furthermore, petunias were not specifically mentioned in any of the accounts of these T&E species as either host plants or as invasive or non-native plants threatening these T&E species.

Scientific Name	Common Name	Family	First Listed	Federal Listing Status
Bombus affinis	Rusty patched bumble bee	Apidae	3/21/2017	Endangered
Hylaeus kuakea	Hawaiian yellow-faced bee	Colletidae	10/31/2016	Endangered
Hylaeus mana	Hawaiian yellow-faced bee	Colletidae	10/31/2016	Endangered
Hylaeus anthracinus	Anthricinan yellow-faced bee	Hylaeidae	10/31/2016	Endangered
Hylaeus assimulans	Assimulans yellow-faced bee	Hylaeidae	10/31/2016	Endangered
Hylaeus facilis	Easy yellow-faced bee	Hylaeidae	10/31/2016	Endangered
Hylaeus hilaris	Hilaris yellow-faced bee	Hylaeidae	10/31/2016	Endangered
Hylaeus longiceps	Hawaiian yellow-faced bee	Hylaeidae	10/31/2016	Endangered
Euproserpinus euterpe	Kern primrose sphinx moth	Sphingidae	4/8/1980	Threatened
Manduca blackburni	Blackburn's sphinx moth	Sphingidae	2/1/2000	Endangered

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B. affinis is known to pollinate a wide variety of plants (Evans et al. 2008), including plants with flowers that contain pelargonidin, such as several varieties of hybrid rose (Biolley and Jay 1993) and the naturalized purple mullein (*Verbascum phoeniceum* var. pink; (Beale et al. 1941). Due to its short glossa (or tongue), *B. affinis* prefers flowers with an open corolla rather than tubular flowers such as petunias. However, at least one field study noted a "tube biting" behavior in which a *B. affinis* bit through the tube of the corolla to reach the nectar (Harder 1985). Therefore, (MacInnis et al. 2019) if *B. affinis* were to bite the petal or otherwise be exposed to the A1-DFR protein, this would not be a novel exposure. It is not likely that it would produce an appreciable response.

The Hawaiian yellow-faced bees in the genus *Hylaeus* (family Colletidae), such as *Hylaeus anthracinus*, *H. facilis*, *H. kuakea*, *H. longiceps*, and *H. mana*, are federally listed as endangered.

The diet of the larval stages is unknown, although it is presumed the larvae feed on stores of pollen and nectar collected and deposited in the nest by the adult female. In 2016, at the time of listing, the bee species occurred in only 22 locations (with some overlap) on six Hawaiian Islands. USFWS considers all five Hawaiian yellow-faced bees vulnerable to extinction due to a combination of habitat change, stochastic events, and the bee species' low numbers and population occurrences (USFWS 2016).

Primary threats to the listed Hawaiian yellow-faced bees include habitat modification and destruction by land use conversion, including urbanization, which fragments foraging and nesting areas used by yellow-faced bees. Incursion of nonnative plants also adversely impacts native plant species in the habitat by modifying the availability of light, altering soil-water regimes, modifying nutrient cycling, increasing the fire frequency, and ultimately converting native dominated plant communities to nonnative plant communities and removing food sources and nesting sites for yellow-faced bees. Habitat modification and destruction by nonnative animals such as goats, feral pigs, cattle, and axis deer is considered one of the primary factors underlying degradation of native vegetation in the Hawaiian Islands, and these habitat changes also remove food sources and nesting sites for the bees. Fire destroys native plant communities on which the yellow-faced bee species depend, and opens habitat for increased invasion by nonnative plants. Events such as drought, hurricanes, and tsunami, can also disturb, modify, and destroy habitat of the yellow-faced bees and provide further opportunities for invasion by nonnative plants, thus eliminating food and nesting resources for the bees (USFWS 2016). *Hylaeus* bees have only very rarely been found visiting nonnative plants for nectar and pollen (Magnacca 2007; USFWS 2016), and are almost completely absent from habitats dominated by nonnative plant species (Daly and Magnacca 2003; USFWS 2016). Petunia or other plants in the Solanaceae plant family were not found among plant species for which *Hylaeus* species are known to visit or collect pollen (Magnacca 2007). Given this preference for their native habitats and native nectar and pollen plants, the presence of A1-DFR petunias, which would not likely occur anywhere but residential and commercial areas of development, would not likely present the occasion for exposure of the listed bees.

Euproserpinus euterpe is limited to a 6.1 ha (5 acre) area in the Walker Basin of Kern County, California. The recovery plan for this species notes that the site has been in grain crop and then cattle production since 1962 (USFWS 1984). Kern primrose sphinx moth has a very close association with its host plant, evening primrose, *Camissonia* spp. (USFWS 1984), which has open, yellow flowers. The main threat to *E. euterpe* is the presence of a non-native filaree plant (*Erodium* spp. in the Geraniaceae family), which the moth will lay its eggs on (and the resulting larvae will not survive). None of the plants associated with the habitat of this moth species are in the Solanaceae family. If A1-DFR petunias were planted in the nearest residential areas, this moth would not likely encounter it and, if it did, it would not likely be associated with it.

M. blackburni (Blackburn's sphinx moth) is known to occur on three of the seven Hawaiian Islands. The moth's habitat has faced impacts from invasion by non-native plant species, urban and agricultural development, habitat degradation and fragmentation, increased wildfire frequency, feral ungulates (goats), while the moth faces direct impacts from non-native parasitoids and insect predators (ants and parasitic wasps) that have significantly reduced the species' range (USFWS 2005). Larvae of this species feed on plants in the Solanaceae family, with their native hosts being four species of *Nothocestrum* (`aiea), two of which (*N. breviflorum* and *N. peltatum*) were federally listed as protected at the time the recovery plan was published in 2005, and a third (*N. latifolium*) that has since been listed (USFWS 2020). The larvae consume the leaves, stems, buds, and flowers of *Nothocestrum* (USFWS 2005).

Many species that act as hosts for Blackburn's sphinx moth are not native to Hawaii. This includes *Nicotiana tabacum* (commercial tobacco), *Nicotiana glauca* (tree tobacco), *Solanum melongena* (eggplant), *Lycopersicon esculentum* (tomato), and possibly *Datura stramonium* (Jimson weed) (USFWS 2005). *Nicotiana* has been hybridized with *petunia* under laboratory conditions, but the resulting hybrid tissue broke down within a year due to genomic incompatibility (Pental et al. 1986). Structurally, *Nicotiana* species are woody perennials in the form of shrubs or trees whereas *Petunia* are herbaceous forbs in form and mainly annual in life cycle and require intentional planting, though they can exist as perennials in places lacking cold temperatures, such as Hawaii. Adult Blackburn's sphinx moths have also has been observed to feed on a variety of other native plants not in the Solanaceae family: *Ipomea indica* (Hawaiian morninglory), *Capparis sandwichiana* (a caper), and *Pleomele auwahiensis* (a halepepe plant); and *Plumbago zeylanica* is also expected to be an adult food source (USFWS 2005). While the moth may encounter GE petunia in its travels across the landscape, the petunia is not likely to occur in the geographic areas under management for recovery of the species. Even if the moth were exposed to petunia, the presence of the DFR gene and the expressed protein should not present any potential harm to the moth given that it is already present in numerous other plants, and pelargonidin derivatives have been identified in the red-purple flowers of *Ipomea purpurea* and other various colored flowers of different plant species (Diretto et al. 2019). *I. purpurea* is related to one *M. blackburnia* host plant, *I. indica*.

6.3 Summary of Potential Effects of A1-DFR Petunias on T&E Species

After reviewing the possible effects of a determination of nonregulated status of A1-DFR petunias, APHIS has not identified any stressor that could affect the reproduction, numbers, or distribution of a listed T&E species or species proposed for listing. As a result, a detailed exposure analysis for individual species is not necessary. APHIS also considered the potential effect of a determination of nonregulated status of A1-DFR petunias on designated critical habitat or habitat proposed for designation, and could identify no differences from effects that would occur from the production of other available petunia varieties. As described above, A1-DFR petunias are not considered a particularly competitive plant species. A1-DFR petunias are not sexually compatible with, nor does it serve as a host species for any listed species or species proposed for listing under the ESA. Consumption of A1-DFR petunias by any listed species or species proposed for listing will not result in a toxic or allergic reaction. Over a hundred varieties of transgenic petunia containing the DFR gene have been on landscape for more than 20 years and APHIS found no reports of any concern or harm to any species associated with the transgenic petunia. APHIS expects no adverse impacts to any listed plant or animal species or critical habitat. Based on these factors, APHIS has concluded that a determination of nonregulated status of A1-DFR petunias, and the corresponding environmental release of this A1-DFR petunia varieties, will have no effect on listed species or species proposed for listing, and would not affect designated habitat or habitat proposed for designation. Because of this "no-effect" determination, consultation under Section 7(a)(2) of the ESA or the concurrences of the USFWS or NMFS are not required.

7 CONSIDERATION OF EXECUTIVE ORDERS, STANDARDS AND TREATIES RELATING TO ENVIRONMENTAL IMPACTS

7.1 Executive Orders Related to Domestic Issues

The following executive orders (EO) require consideration of the potential impacts of federal actions to various segments of the population.

- **EO 12898 – Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations**

  This EO requires federal agencies to conduct their programs, policies, and activities that substantially affect human health or the environment in a manner so as not to exclude persons and populations from participation in or benefiting from such programs. It also enforces existing statutes to prevent minority and low-income communities from being subjected to disproportionately high and adverse human health or environmental effects.

- **EO 13045 – Protection of Children from Environmental Health Risks and Safety Risks**

  Children may suffer disproportionately from environmental health and safety risks due to their developmental stage, higher metabolic rates, and behavior patterns, as compared to adults. This EO requires each federal agency to identify, assess, and address the potential environmental health and safety risks that may disproportionately affect children.

The No Action and Preferred Alternatives were analyzed with respect to EO 12898 and EO 13045. Neither alternative evaluated in this EA is expected to have disproportionate adverse impacts on minorities, low-income populations, or children. As reviewed in Chapter 3 and 4, it is highly improbable the trait genes and gene products in A1-DFR petunias present any risks to human health, nor to animal health and welfare. A1-DFR petunias would be produced and marketed as are all other petunia varieties, using the same growing practices and inputs.

- **EO 13175 – Consultation and Coordination with Indian Tribal Governments**

  Executive departments and agencies are charged with engaging in consultation and collaboration with tribal governments; strengthening the government-to-government relationship between the United States and Indian tribes; and reducing the imposition of unfunded mandates upon Indian tribes. This EO emphasizes and pledges that federal agencies will communicate and collaborate with tribal officials when proposed federal actions have potential tribal implications.

Tribal entities are recognized as independent governments and agricultural activities on tribal lands would only be conducted if approved by the tribe. Tribes would have control over any potential conflict with cultural resources on tribal properties. Approval nor denial of the petition is not expected to have any effect on Indian tribal self-governance or sovereignty, tribal treaties, or other rights.

Consistent with EO 13175, APHIS sent a letter of notification and request for comment and consultation on the proposed action to federally recognized tribes on August 2, 2019. This letter contained information regarding the Westhoff petition request and A1-DFR petunias. Additionally, this notification asked tribal leaders to contact APHIS if they believed that there were potentially significant impacts to tribal lands or resources that should be considered. APHIS will continue to consult and collaborate with tribal officials to ensure that they are well-informed and represented in policy and program decisions that may impact their agricultural interests, in accordance with EO 13175. A determination of nonregulated status for A1-DFR petunias will not adversely impact cultural resources on tribal properties.

The No Action and Preferred Alternatives were analyzed with respect to EO 12898, EO 13045, and EO 13175. Neither alternative is expected to have a disproportionate adverse impact on minorities, low-income populations, or children. Nor is any alternative expected to have potential Tribal implications.

- **EO 13751 – Safeguarding the Nation from the Impacts of Invasive Species**

  Invasive species are a significant issue in the United States, causing both adverse economic and environmental impacts. This EO directs federal agencies to take action to prevent the introduction of invasive species, to provide for their control, and to minimize the economic, ecological, and human health impacts that invasive species cause.

Petunia is not listed in the United States as a noxious weed species by the Federal government (USDA-NRCS 2019c), nor is it listed as an invasive species by major invasive plant data bases. Based on observations and data submitted by the applicant and reviewed by APHIS, A1-DFR petunias are similar in fitness characteristics to other petunia varieties currently grown and is not expected to become more weedy or invasive than conventional petunia. As part of its PPRA, APHIS evaluated the potential weediness and invasiveness of A1-DFR petunias and concluded that it is unlikely that A1-DFR petunias will become weedy or invasive in areas where it is grown (USDA-APHIS 2020).

- **EO 13186 – Responsibilities of Federal Agencies to Protect Migratory Birds**

  Federal agencies taking actions that have, or are likely to have, a measurable negative effect on migratory bird populations are directed to develop and implement, within two years, a Memorandum of Understanding (MOU) with the Fish and Wildlife Service that shall promote the conservation of migratory bird populations.

Petunias can provide food sources for migratory birds, specifically hummingbirds, along migratory routes in North America. Migratory birds may visit petunias to feed on nectar or insects on petunia plants, which provides a valuable source of nutrition to migratory birds. As reviewed in Chapter 4, it is highly unlikely the trait genes and their products present any risks to the health of migratory birds. Pelargonidin occurs naturally in several food plants, on which birds may forage and the *nptII* gene and associated NPTII enzyme are present in soil and aquatic bacteria and animal gastrointestinal flora (Smalla et al. 1993; Lopes-da-Silva et al. 2001; EFSA 2004; Welch et al. 2008; Maleka et al. 2013; Diretto et al. 2019). The genes and gene products inserted into A1-DFR petunias are already found in the environment. Because migratory birds that forage on A1-DFR petunias are unlikely to be adversely affected by ingesting the nectar or other plant parts, it is unlikely that a determination of nonregulated status for A1-DFR petunias would have a negative impact on migratory bird populations.

7.2 Executive Orders Relative to International Issues

- **EO 12114 - Environmental Effects Abroad of Major Federal Actions**

  This Order requires federal officials to take into consideration any potential environmental effects that may occur outside the United States, its territories, and possessions, that may result from actions being taken.

The United States is a member of the World Trade Organization (WTO), which facilitates harmonizing the global rules of trade between nations. The Agreement on the Application of Sanitary and Phytosanitary Measures (the "SPS Agreement"), entered into force with the establishment of the WTO on January 1, 1995, sets out the basic rules for food safety and animal and plant health standards. The SPS agreement recognizes three international organizations/frameworks that have established standards and guidelines related to SPS measures (WTO 2019a), these are; the Codex Alimentarius Commission (Codex), the World Organization for Animal Health (OIE), and the International Plant Protection Convention (IPPC). Any international trade of A1-DFR petunias following a determination of nonregulated status would be subject to national phytosanitary requirements and be in accordance with international SPS standards, inclusive of the IPPC (plant pests and disease).

All crop production can potentially have adverse impacts on soils, and air and water quality. Any cultivation of A1-DFR petunias outside of the United States, its territories, or possessions would utilize the same (or similar) growing practices and inputs as those utilized in the United States. Consequently, the sources and degree of environmental impacts that derive from petunia production abroad would be no different than those described for the United States, as discussed in this EA. APHIS does not expect a significant environmental impact outside the United States in the event of a determination of nonregulated status of A1-DFR petunias.

7.3 Federal Laws and Regulations

The laws most relevant to APHIS determinations of regulatory status are the National Environmental Policy Act of 1969 (NEPA), the Clean Water Act of 1972 (CWA), the Safe Drinking Water Act of 1974 (SDWA), the Clean Air Act of 1970 (CAA), the Endangered Species Act of 1973 (ESA), and the National Historic Preservation Act of 1966 (NHPA). Compliance with the requirements of the ESA has been addressed in Chapter 6. Compliance with the requirements of NEPA, CWA, SDWA, CAA, and NHPA, are specifically addressed in the following subsections.

7.3.1 National Environmental Policy Act (NEPA)

NEPA (42 United States Code (U.S.C) 4321, *et seq*.) is designed to ensure transparency and communication of the possible environmental effects of federal actions prior to implementation. The Act and implementing regulations require federal agencies to document, in advance and in detail, the potential effects of their actions on the human environment, so as to ensure that there is a full understanding of the possible environmental outcomes of federal actions by both the decision-makers and the public. This EA documents the potential environmental outcomes of the alternatives considered, approval or denial of Westhoff's petition, and is consistent with the requirements of NEPA and Council on Environmental Quality implementing regulations at 40 CFR parts 1500-1508.

7.3.2 Clean Air Act (CAA), Clean Water Act (CWA), and Safe Drinking Water Act (SDWA)

The CAA, CWA, and SDWA authorize the EPA to regulate air and water quality in the United States. Because A1-DFR petunias are agronomically/horticulurally equivalent to currently cultivated petunia varieties, with the exception of the new color, the potential sources of impacts on water resources and air quality are the same under both the No Action and Preferred Alternatives. Production of A1-DFR petunias would entail the use of pesticides and fertilizers, which will contribute to potential cumulative impacts on air quality, and potentially water quality. The sources and degree of potential impacts would be no different than that which occurs with current petunia production. APHIS assumes use of all pesticides on A1-DFR petunias will be compliant with the EPA registration and label requirements. As discussed in Chapters 3 and 4, the change in color in A1-DFR petunias presents no known risks to water or air quality. Considering these factors, a determination of nonregulated status for A1-DFR petunias would not lead to circumstances that resulted in non-compliance with the requirements of the CWA, CAA, and SDWA.

7.3.3 National Historic Preservation Act (NHPA)

The NHPA of 1966 and its implementing regulations (36 CFR part 800) requires federal agencies to: 1) determine whether activities they propose constitute "undertakings" that have the potential to cause effects on historic properties and 2) if so, to evaluate the effects of such undertakings on such historic resources and consult with the Advisory Council on Historic Preservation (i.e., State Historic Preservation Office, Tribal Historic Preservation Officers), as appropriate.

A determination of nonregulated status for A1-DFR petunias is not a decision that would directly or indirectly result in alteration of the character or use of historic properties protected under the NHPA, nor would it result in any loss or destruction of cultural or historical resources.

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