



Coexistence Principles & Glossary of Terms

INTRODUCTION

The first genetically enhanced (GE) trait in alfalfa, Roundup Ready® Alfalfa (RRA), was deregulated (approved by the USDA for growing) and initially made available to growers in June 2005. Plantings were subsequently suspended in March 2007 pending a court-ordered completion of a USDA Environmental Impact Statement (EIS). An EIS was completed in December 2010, and the trait was again deregulated in February 2011. Other GE traits for improved crop production and/or forage quality are under development by several parties. At the same time, novel products and production systems are developing. It is important the industry have stewardship programs that allow growers to incorporate specific traits, quality standards and production systems to capture value in specific markets. This document outlines general coexistence principles, an overview of seed production tools and strategies for managing pollen-mediated gene flow, a decision tree to summarize how these tools may be employed and a glossary of terms.

COEXISTENCE PRINCIPLES

Alfalfa seed and hay growers benefit from a diversity of markets. Conventional, GE and organic seed and hay sold to domestic and export markets may require very different quality parameters, enforced by process, results-based certification and/or contracts between supplier and buyer. These provide a potential value-added opportunity to growers. Although it should be the right of every grower to choose the market he/she produces for and the technology they employ in their production system, stewardship programs and required production practices may mandate minimum isolation standards to facilitate coexistence of these various products and markets.

Coexistence is not a new phenomenon in agriculture. The seed certification program, now 70 years old, allows for the coexistence of seed production of various varieties in the same area based on crop biology, production system and isolation that ensure seed genetic purity. Coexistence programs have been successfully adopted by growers of most crops for seed production and products such as sweet corn, where neighboring crops may affect marketability of a specific quality trait. The NAFA coexistence documents are designed to examine strategies for coexistence of GE, conventional and Adventitious Presence Sensitive (APS) markets. Conventional alfalfa seed and hay sold in most domestic markets is generally AP-tolerant (APT) to low level AP. This parallels the U.S. industry experience for AP of GE traits in conventional corn, soybean and cotton. NAFA *Best Management Practices for Roundup Ready Alfalfa Seed Production* (NAFA GE BMP) are designed to adequately address this APT market. Like all standards in agriculture and food systems, these standards do not aim for 100% purity. The tolerance for low level AP in seed and hay sold to APS markets will be a market-based standard and will likely evolve with time. For example, efforts are underway to establish new tolerance levels for AP of U.S. approved GE traits in alfalfa seed exported to important export countries (potentially less restrictive) and the organic community is examining adoption of a new common AP standard for seed, feed and food products (potentially more restrictive).

Scientific data and decades of experience in the seed and hay industries are the appropriate basis for developing coexistence and stewardship programs that are responsive to changing agricultural markets. Growers of GE alfalfa seed and hay will need to rigorously apply stewardship programs designed and adopted by the industry to facilitate coexistence. Growers serving APS markets must understand any contractual quality specifications guaranteed and their ability to deliver those specifications to their customers (CropLife, 2006; SCIMAC, 2006; Sundstrom et al., 2003; Woodward, 2006). Science, process-based stewardship programs and tools for monitoring the efficacy of such programs are key tools for coexistence. Coexistence will also be based on good communication and mutual respect between neighbors, individuals and companies who have adopted different approaches to agriculture or identified different market opportunities. The U.S. alfalfa industry is well-developed and capable of addressing specialized contract requirements and has a proven history of successfully delivering quality products to meet various customer specifications.

STRATEGIES & TOOLS FOR AP-SENSITIVE ALFALFA SEED PRODUCTION

APS markets are and will likely continue to be important components of the U.S. alfalfa seed industry. Several components of a strategy for managing pollen-mediated gene flow are described below. These tools are important components of NAFA's overall coexistence strategy and critical for managing seed production for APS markets.

Association of Official Seed Certifying Agencies (AOSCA) Certified Seed Standards Role. Alfalfa seed production in the U.S. is concentrated in specific growing areas within the eight western states where conditions

have proven favorable for alfalfa seed production. Within these concentrated seed production areas, the AOSCA program requirements for production of certified alfalfa seed have been effective at ensuring genetic integrity of varieties and seed lots. The basic AOSCA seed certification program tools include: genetic purity of seedstocks, appropriate spatial isolation between commercial seed production fields and neighboring alfalfa seed/hay production or feral plants, and a required crop rotation between seed production of different varieties on the same land. The AOSCA seed certification program was designed to reduce genetic off-types to < 2%. With the introduction of GE traits in alfalfa, genetic off-types can include the unintended low level AP of GE traits in conventional seed. In markets where there is an AP threshold below 2%, more stringent application of the AOSCA seed certification tools will be needed.

NAFA Best Management Practices for Roundup Ready Alfalfa Seed Production Role. NAFA GE BMP is a science-based stewardship program that mandates isolation standards for new RRA seed production fields. Isolation requirements are based on an AP threshold of 0.5%, typical of the AP thresholds established for U.S. domestic conventional seed sales for other GE crops. The isolation standards are pollinator-specific and based on several alfalfa pollen flow studies conducted 2003-2007, and summarized in a review publication by Council for Agricultural Science and Technology (CAST) (VanDeynze et al., 2008). NAFA has enlisted a panel of AOSCA experts to conduct an annual review of efficacy of the NAFA GE BMP. The alfalfa genetic supplier members of NAFA are also the major growers of alfalfa seed. These companies are testing conventional seed lots for the presence of GE on a routine basis and submitting data to the AOSCA expert panel for evaluation. The AOSCA expert panel pools and evaluates the data to determine if NAFA GE BMP are effective in meeting the program goals. This allows a real-time, large scale method of monitoring program efficacy. The data can serve as a science-based tool for making adjustments in isolation distances, if needed. NAFA GE BMP are designed primarily for the production of alfalfa seed destined for domestic markets.

In many cases seed of the same cultivar is sold in both conventional and APS markets and a seed lot of the cultivar destined for an APS market may be identified that meets a specific AP threshold market requirement. However, there will be many cases where alfalfa seed production for markets where the AP threshold is < 0.5% (APS Markets), will need isolation between GE and APS seed production that exceeds NAFA GE BMP requirements.

AP-Sensitive Alfalfa Seed Markets and AP Thresholds. In this document an APS alfalfa seed market is defined as any market in which there is an established AP threshold < 0.5%. This will include both domestic and export market segments. Putnam (2008) estimates that approximately 5% of the U.S. domestic market may be APS, including the approximate 1% of U.S. alfalfa forage acres produced under the National Organic Program. Until and unless GE traits become deregulated, or new AP thresholds are established in

key alfalfa seed export countries, most of the alfalfa seed exported from the U.S. is APS.

Although there is no uniform AP threshold for all APS seed markets, many APS markets have adopted a “non-detect” standard. Such a standard certifies that there is no detection of the trait in a seed sample of a certain size. A recognized test, that meets many APS market requirements, uses protein-based test strips to determine presence of the RRA trait in three 600 seed samples. If there is no detection in any of the three samples, there is 95% certainty that AP < 0.1%, and the seed lot meets the non-detect standard. Most seed companies currently use this test to characterize every seed lot destined for export to APS seed markets.

AP-Sensitive Seed Production Tools

Quality Control in Alfalfa Breeding Lines and Seedstock. Both commercial and public plant breeding programs in the U.S. have always been committed to rigorous quality control programs ensuring genetic purity in breeding programs, breeding lines and seedstock production. These practices have almost always met or exceeded those required by AOSCA Seed Certification. Core principles of these quality control programs include precise characterization of breeding lines, continual monitoring for and eliminating off-types, extraordinary isolation in seed production and rigorous process protocols for eliminating potential cross-contamination of plants and/or seed lots in the breeding program. In the age of GE traits, these quality control programs have evolved to include more precise testing and more rigorous best practice protocols. A key tenant to production of alfalfa seed for APS markets is to have breeding lines and seedstock that meet precise non-detect standards. This is now common practice for U.S. alfalfa breeding companies and a specific requirement of the AOSCA Alfalfa Seed Stewardship Program (ASSP) program described later in this document.

AOSCA ASSP Process Verification. In 2009, the industry began conversations with AOSCA to develop a process-based certification system that could be used to supplement or substitute for the seed testing protocols described above. In 2010, AOSCA launched the ASSP, a voluntary, fee-based identity preserved program of process certification for the production of alfalfa seed destined for APS markets. This identity preserved process certification includes the testing and third party verification of genetic origin and non-detect GE trait status of planting seedstock and observance of a minimum stated isolation distance from GE alfalfa seed production. The Idaho Crop Improvement Association (ICIA, 2008) manages a similar process-based certification for sweet corn seed produced for export markets. This certification has been widely embraced by both sweet corn seed growers and the export markets to which they sell. The alfalfa seed industry strongly encouraged the development and implementation of the new AOSCA identity preserved program which is well suited to serve the needs of APS alfalfa seed growers.

California Crop Improvement Association (CCIA) Alfalfa Pinning Map. Effective communication between seed production companies will be an important aid to

coordinating seed production planning and in effectively segregating GE and APS seed production. There will be formal and informal communication channels. To establish a formal system of communications between seed producing companies, in 2010 the industry collaborated with CCIA to develop a web-based alfalfa seed field isolation “pinning” map for alfalfa seed production in the Western U.S. The seed certifying agencies in all major western alfalfa seed production areas are planning to utilize this asset to assist the industry in coexistence efforts. Participants are pinning both ASSP and GE alfalfa seed production fields as a tool to concentrate and segregate alfalfa seed production destined for these different market segments.

AP-Sensitive Grower Opportunity Zones. Grower Opportunity Zones (GOZ) are defined as specific geographic regions wherein a super-majority of alfalfa seed growers elect to produce either APS and conventional or GE and APT conventional alfalfa seed production. It will be a primary tool in helping concentrate and segregate alfalfa seed production for APS and GE markets. By definition an APS GOZ will not allow GE alfalfa seed production, facilitating meeting the seed production isolation requirements of ASSP. Imperial County, CA, is the largest seed production county in the U.S., and although not formally an APS GOZ, has and will have ongoing stewardship restrictions to planting either GE alfalfa seed or hay production in the county, ensuring all Imperial County alfalfa seed production meets ASSP isolation requirements.

ALFALFA COEXISTENCE GLOSSARY

Adventitious Presence (AP) – low level unintentional introduction of GE trait in seed.

AP-Free (APF) – defines markets requiring non-detect AP in a very sensitive PCR-based assay (e.g., EuroFins test procedures).

AP-Sensitive (APS) – generally defines markets that are more sensitive to AP than typical domestic markets (e.g., export or organic seed market requiring non-detect AP in a defined protein-based assay).

AP-Tolerant (APT) – generally defines markets where AP is acceptable within industry standards.

Alfalfa Seed Stewardship Program (ASSP) - an AOSCA process-based identity preserved program certifying that certain activities and standards are met for seed production intended for an APF/APS market. If AOSCA verifies that the seed production process meets program requirements, no seed testing is required and an ASSP certificate is awarded. If program requirements cannot be met, testing is required to show seed meets specific AP levels, and if so, an ASSP certificate is awarded. This marketing program is designed to facilitate export of U.S. produced alfalfa seed, and is structured similarly to a successful AOSCA program facilitating sweet corn seed export. The program is administered locally by member state seed certifying agencies on a fee-for-service basis.

California Crop Improvement Association (CCIA) Pinning Map – a U.S. map maintained by the CCIA

showing real-time location of alfalfa seed and/or hay production fields by type.

Genetically Enhanced (GE) – a trait, or variety containing such trait, that is the result of genetic engineering. GE traits are generally covered by one or more U.S. patents and seed production or planting of GE varieties is subject to specific stewardship requirements.

Grower Opportunity Zone (GOZ) – a seed grower defined geography within which a super-majority $\geq 80\%$ of alfalfa seed growers, or alfalfa seed growers representing $>80\%$ of the alfalfa seed production acres, elect to focus on the production of either APS or GE alfalfa seed (including RRA), facilitating meeting isolation requirements for these markets. (GOZ is described in greater detail in a related NAFA coexistence document, *Grower Opportunity Zones for Seed Production*.)

NAFA Best Management Practices (BMP) –

- *Best Management Practices for Roundup Ready Alfalfa Seed Production* adopted by NAFA for the production of RR alfalfa (GE) seed. The GE BMP includes seed contractor and grower requirements for producing RR alfalfa in areas that are not designated as a GE GOZ.
- *Best Management Practices for AP-Sensitive Alfalfa Seed Production* adopted by NAFA for the production of APS seed. The APS BMP includes seed contractor and grower requirements for producing APS alfalfa seed.

Low Level Presence (LLP) – low level unintentional introduction of GE trait in hay.

ALFALFA SEED PRODUCTION DECISION TREE (see Appendix)

The market class of the alfalfa seed produced (i.e., GE, APT, APS or APF) and whether or not the planting is in a GOZ, will govern which of the production practices and/or stewardship programs discussed in the previous section are recommended or required.

The Alfalfa Seed Production Decision Tree (tree and corresponding table) outlines the applicable seed production practices and/or stewardship programs for each combination of growing area/production zone and seed type/market class. The table shows whether the production limitations/stewardship programs apply, are an option, or not applicable.

Example I: In an APS-GOZ, only Certified Seed standards apply to APT seed production; no GE seed production is allowed; and ASSP standards are an option for APS and APF seed if ASSP certification is desired.

Example II: In a GE-GOZ the isolation distance between GE and APT seed will conform with AOSCA Certified Seed standards, additionally, GE seed production will conform with the NAFA GE BMP for all elements other than isolation distances (which will be AOSCA Cert. isolation distances).

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The National Alfalfa & Forage Alliance (NAFA) strongly supports the availability and continued use of biotechnology in agriculture. These advances will allow American farmers to effectively compete in the world market and will enable American farmers to supply abundant, safe, high quality food, fiber and renewable fuel desired by global consumers. NAFA acknowledges and respects different markets and methodologies of food, fiber and renewable fuel production. We believe that science based stewardship management practices allow for the coexistence of these different markets and methodologies in production agriculture. NAFA believes collaborative efforts among all stakeholders are required to develop methodologies that enable coexistence.

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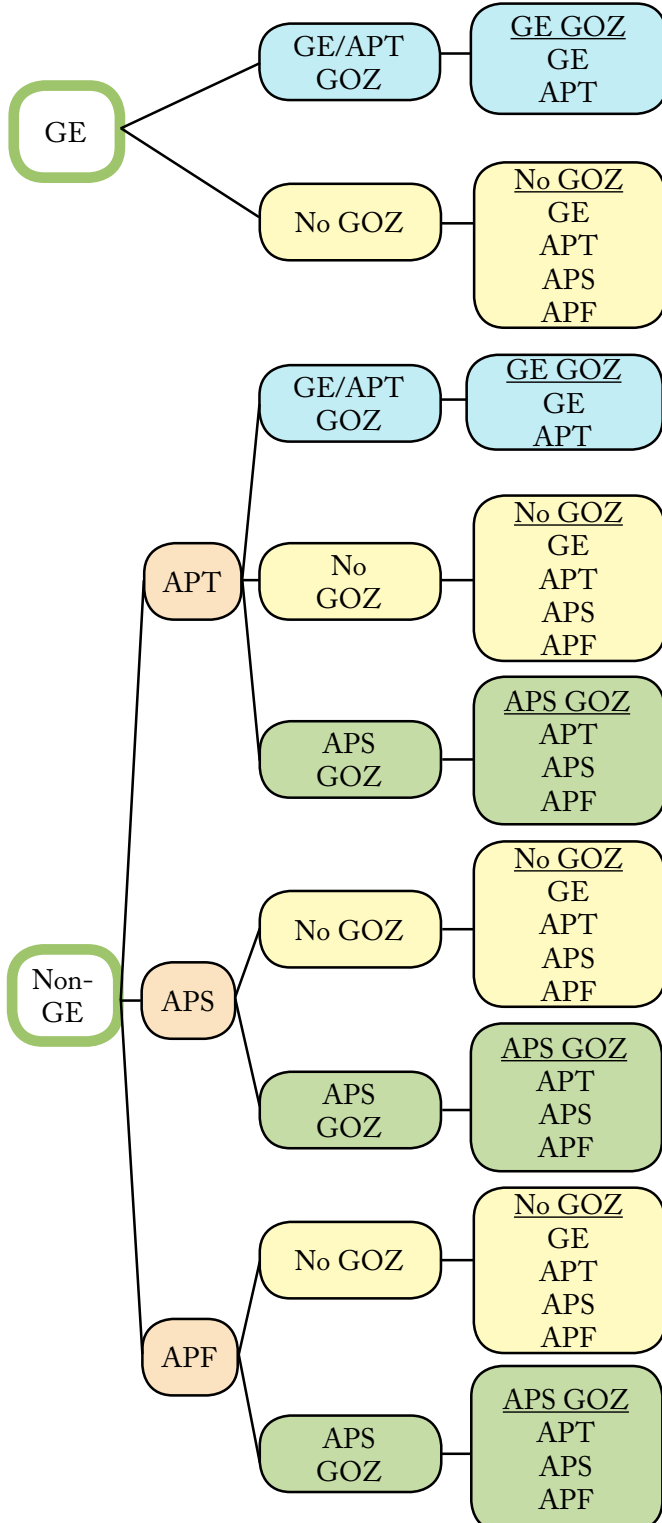
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Appendix - Alfalfa Seed Production Coexistence Decision Tree

Seed Type or Intended market	Growing Area Type	Combined Seed Type by Growing Area
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Isolation Distance and/or Program Requirements				
AOSCA Cert.	AOSCA ASSP	NAFA GE BMP	NAFA APS BMP	Key Considerations
Yes	N/A	*Yes	N/A	AOSCA Cert. isolation applies
Yes	Optional	Yes	Optional	Pinning Map to help segregate GE/non-GE
Yes	N/A	*Yes	N/A	AOSCA Cert. isolation applies
Yes	Optional	Yes	Optional	Pinning Map to help segregate GE/non-GE
Yes	Optional	N/A	Yes	No GE seed production allowed
Yes	Optional	Yes	Yes	Pinning Map to help segregate GE/non-GE
Yes	Optional	N/A	Yes	No GE seed production allowed
Yes	Optional	Yes	Yes	Pinning Map to help segregate GE/non-GE
Yes	Optional	N/A	Yes	No GE seed production allowed



*NAFA GE BMP applies except the NAFA GE BMP isolation distances will be replaced with AOSCA Cert. isolation distances.