NAFA Coexistence Document

June 2015

Coexistence Principles & Glossary of Terms

INTRODUCTION

In January, 2011, the U.S. Department of Agriculture's Animal and Plant Health Inspection Service (APHIS) granted non-regulated status to the first Genetically Enhanced alfalfa (GEA) - Roundup Ready® alfalfa (RRA), genetically enhanced to be resistant to the herbicide commercially known as Roundup®. In November, 2014, APHIS similarly granted non-regulated status to HarvXtra alfalfa, genetically enhanced to reduce lignin content. USDA's APHIS is responsible for determining the status of a given trait through a deliberative process which includes an Environmental Assessment (EA) or Environmental Impact Statement (EIS) and several public comment opportunities.

Due to the fact that additional traits may be introduced over time, it is important that the industry have mechanisms to maintain production practices for specific markets which may reject or be sensitive to genetically enhanced (GE) traits, while allowing for the adoption of new technologies - this is termed coexistence.

This National Alfalfa & Forage Alliance (NAFA) 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, genetically enhanced (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, over 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 adventitious presence (AP). This parallels the U.S. industry experience for AP of GE traits in conventional corn, soybean and cotton. NAFA Best Management Practices for Genetically Enhanced Alfalfa Seed Production (NAFA BMP for GEA Seed Production) 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.

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 GEA 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 primarily in 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 may be needed.

NAFA Best Management Practices for Genetically Enhanced Alfalfa Seed Production Role, NAFA BMP for GEA Seed Production is a science-based stewardship program that mandates isolation standards for GEA 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 the 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 BMPs. 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 BMPs 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 BMP for GEA Seed Production is designed primarily for the production of alfalfa seed destined for domestic markets and those markets with established low level presence (LLP) tolerances.

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 BMP for GEA Seed Production 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. Currently less than 1.5% of the U.S. alfalfa forage acres are 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 "nondetect" 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 and/or DNA-based PCR tests to determine presence of the GEA trait. For example, when using test strips, there is a universal standard for the genetic purity of seed. If no GE seeds are found in a 3,000 seed sample (five 600 seed samples) there is 95% probability that the actual AP level in the seed lot is between 0 and 0.1%, and the seed lot meets the non-detect standard (SeedCalc; International Seed Testing Association). Most seed companies currently use this test and/or DNA-based PCR tests to characterize every seed lot destined for export to APS seed markets, and for stock seed planted in APS GOZs, the Imperial Valley, Australia and Canada.

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 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 nondetect standards. This is a common practice for U.S. alfalfa breeding companies and a specific requirement of the AOSCA Alfalfa Seed Stewardship Program (ASSP) described later in this document.

AOSCA ASSP Process Verification. 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 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 is important to coordinating seed production planning and in effectively segregating

GE and APS seed production. There are 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 U.S. The seed certifying agencies in all major western alfalfa seed production areas are utilizing this asset to assist the industry in coexistence efforts. Participants should pin ASSP, APS and GE alfalfa seed production fields as a tool to concentrate and segregate alfalfa seed production destined for these different market segments.

Grower Opportunity Zones (GOZ). A GOZ is a seed grower defined geography within which a validated super-majority ≥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, facilitating meeting isolation requirements for these markets. Within either GOZ, conventional AP-tolerant (APT) seed can be produced in accordance with the applicable NAFA BMP for that GOZ. The formation of such GOZs facilitates seed production of GE and APS alfalfa seed, and thus allows the alfalfa seed industry to meet the demands of various markets. There are market driven incentives that encourage the formation of GOZs by seed growers.

Additionally, Imperial County, CA, is the largest seed production county in the U.S., and although not formally an APS GOZ, has 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) - markets requiring non-detect AP in a very sensitive PCR-based assay (e.g., EuroFins test procedures).

AP-Sensitive (APS) - 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) - markets where AP is acceptable within industry or regulatory 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 validated supermajority ≥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, 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 Genetically Enhanced Alfalfa Seed Production adopted by NAFA for the production of GEA seed. The BMP includes seed contractor and grower requirements for producing GEA in areas that are designated as a GE GOZ.
- Best Management Practices for AP-Sensitive Alfalfa Seed Production adopted by NAFA for the production of APS seed. The 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, governs 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 BMP for GEA Seed Production for all elements other than isolation distances (which will be AOSCA Certification 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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Contributing Authors - 2011

Ron Cornish, Dairyland Seed Company, West Bend, WI Paul Frey, Cal/West Seeds, Woodland, CA Mark McCaslin, Forage Genetics International, St. Paul, MN Dave Miller, Pioneer Hi-Bred International, Arlington, WI Allen VanDenyze, University of California, Davis, CA

Coexistence Committee - 2011

Mark Wagoner, Washington Alfalfa Seed Commission Touchet, WA

Leland Tiegs, Idaho Alfalfa & Clover Seed Commission Nampa, ID

Jeff Yribarren, California Alfalfa Seed Prod. Research Brd. Kerman, CA

Larry Tueber, California Crop Improvement Association Davis, CA

Mike Moore, Wyoming Crop Improvement Association Powell, WY

Paul Frey, Cal/West Seeds Woodland, CA

Mark McCaslin, Forage Genetics International St. Paul, MN

Dave Miller, Pioneer Hi-Bred International Arlington, WI

Ron Cornish, Dairyland Seed Company West Bend, WI

Editor

Beth Nelson, President, NAFA, St. Paul, MN

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Seed Type or Intended	Growing Area	Combined Seed Type by	Isolation Distance and/or Program Requirements				
market	Туре	Growing Area	AOSCA Cert.	AOSCA ASSP	NAFA GE BMP	NAFA APS BMP	Key Considerations
GE	GE/APT GOZ	GE GOZ GE APT	Yes	N/A	*Yes	N/A	AOSCA Cert. isolation applies
	No GOZ	GE APT APS APF	Yes	Optional	Yes	Optional	Pinning Map to help segregate GE/non-GE
	GE/APT GOZ	$ \begin{array}{c} \underline{GE GOZ} \\ GE \\ APT \end{array} $	Yes	N/A	*Yes	N/A	AOSCA Cert. isolation applies
Non- GE APS	No GOZ	Mo GOZ GE APT APS APF	Yes	Optional	Yes	Optional	Pinning Map to help segregate GE/non-GE
	APS GOZ	APS GOZ APT APS APF	Yes	Optional	N/A	Yes	No GE seed production allowed
	N ₀ GOZ	GE APT APS APF	Yes	Optional	Yes	Yes	Pinning Map to help segregate GE/non-GE
	APS GOZ	APS GOZ APT APS APF	Yes	Optional	N/A	Yes	No GE seed production allowed
API	No GOZ	Mo GOZ GE APT APS APF	Yes	Optional	Yes	Yes	Pinning Map to help segregate GE/non-GE
	APS GOZ	APS GOZ APT APS APF	Yes	Optional	N/A	Yes	No GE seed production allowed

^{*}NAFA BMP for RRA Seed Production applies except the BMP isolation distances will be replaced with AOSCA Cert. isolation distances.