Coexistence for Alfalfa Hay Export Markets

Introduction

The first genetically engineered (GE) trait in alfalfa, Roundup Ready®, was initially made available June, 2005, through March, 2007; plantings were subsequently suspended pending further regulatory review. Other GE traits for improved crop production and value are under development. It is important that the industry have mechanisms to maintain current production practices for specific markets which may reject or be sensitive to new GE traits, while allowing for the adoption of new technologies which are deemed to be safe, effective and economically valuable.

This National Alfalfa & Forage Alliance (NAFA) document addresses coexistence issues relevant to alfalfa hay exporters. Coexistence issues specific to alfalfa seed exporters and organic alfalfa seed and hay producers are addressed in companion documents.

Alfalfa Hay Export Markets

In 2006, there were 23.5 million acres of alfalfa harvested in the U.S., including 21.5 million acres harvested as hay, and 2.0 million acres harvested as silage (USDA, 2007). Exports are almost exclusively the purview of Western U.S.; very little hay is exported from the Midwest or East. Although theoretically silage could be exported, all exports currently consist of compressed hay, cubes, and meals, predominately double compressed hay.

Japan is the largest single importer of U.S. hay. In 2006, Japan imported 73% of the total U.S. hay exported (Table 1). This includes both alfalfa and other hay products. Japan, Korea, Taiwan, Canada and Mexico represent over 95% of the U.S. hay export market (Table 2). The major importers of U.S. alfalfa meal and pellets in 2005 were Japan (85%), China (9.5%) and UAE (4.1%).

Table 1. All hay exports from CA, OR and WA ports, 2006.

	Japan		Other Countries		Total	
	MT	%	MT	%	MT	%
CA Ports	694,516	36%	241,333	33%	935,849	35%
OR/WA Ports	1,246,055	64%	486,495	67%	1,732,550	65%
Total	1,940,571	73%	727,828	27%	2,668,399	100%

Note: Includes alfalfa, sudangrass, timothy, oat and some straw.
USDA-Foreign Agricultural Service.

Since alfalfa is the only hay product potentially containing a GE trait, alfalfa must be considered separately from other hay products (e.g., oat, sudangrass, timothy and various straw products). Alfalfa hay and cube exports (as distinct from all hay exports) are shown in Table 2. Although all hay exports may be greater than 2.5 million metric tons, exports of alfalfa hay are approximately 740,000 to 1.14 million tons, or 1/3 of all hay exports.

Table 2. Alfalfa hay, cubes and meal exported from the US, 2001-2006.

Country	2001	2002	2003	2004	2005	2006
Japan	524,090	786,409	869,648	865,317	750,907	680,769
Korea (Rep.)	122,475	133,935	127,657	109,634	100,796	128,331
Taiwan	35,779	72,756	55,574	58,876	62,426	68,662
Canada	41,251	47,517	64,683	65,113	62,114	39,447
UAE	9,004	10,034	4,552	13,197	15,810	19,864
Mexico	3,149	5,669	12,497	12,967	23,388	8,987
Hong Kong	0	450	923	1,065	1,070	1,087
China (PRC)	982	880	611	127	251	420
UK	4,310	2,175	1,602	418	776	407
All Other	2,127	6,996	5,481	9,875	3,166	2,623
Total	**743,167**	**1,066,821**	**1,143,228**	**1,136,589**	**1,020,704**	**950,597**

USDA-Foreign Agricultural Service (MT).

Between 65 and 72 million tons of alfalfa and alfalfa hay mixtures are produced in the U.S., depending upon year (Table 3). Seven western states (AZ, CA, ID, NV, OR, UT, WA) represent 28 to 34% of U.S. alfalfa hay production and greater than 99% of U.S. alfalfa exports. Nationwide, approximately 1 to 1.5% of the harvested alfalfa hay crop is sold for export (Table 3). However, export hay consists of about 3.6 to 5.3% of the production of these same western states.

Exports are a more significant percentage of the local hay production acreage in specific regions, notably the Columbia Basin of Washington and the Imperial Valley of California, and specific locations in several other western states, where exports are a key market. In these regions, alfalfa hay produced for export markets is an important part of

the agricultural economy. Washington hay producers collected over $3.5 million from export hay sales in 2006. Thus, in these specific regions, the sensitivity of the export market for GE traits is likely to be more intense. However, for the vast majority of U.S. alfalfa production regions, and even for the majority of the alfalfa production regions in western states, export hay is not important. Market sensitivity for export alfalfa is mostly confined to those producers and specific regions where export hay is common.

Table 3. Total production and exports of alfalfa and alfalfa mixtures, of the US and seven western US states (AZ, CA, ID, NV, OR, UT, WA).

	2001	2002	2003	2004	2005	2006
Total US Production (MT)	72,881,078	66,223,698	69,179,611	68,461,267	69,067,143	65,309,442
Alfalfa Production - Seven Western States (MT)	20,631,989	22,524,012	22,379,105	21,427,545	21,188,264	21,654,900
Quantity Exported US (MT)	743,167	1,066,821	1,143,228	1,136,589	1,020,704	950,597
Percentage of Alfalfa Exported (Seven States Total)	3.6%	4.7%	5.1%	5.3%	4.8%	4.4%
Percentage of US Alfalfa Exported	1.0%	1.6%	1.7%	1.7%	1.5%	1.5%

Notes: USDA-National Agricultural Statistics Service Data for production. USDA-Foreign Agricultural Service data for exports. It is assumed that 100% of exports are from these seven western states.

Sensitivity of Alfalfa Export Markets

There are two separate issues with regard to the sensitivity of export markets to GE trait in alfalfa hay.

Regulatory Approval by Importing Country. Regulatory approvals for the importation of Roundup Ready alfalfa feed and/or food purposes has been granted by Japan, Canada, Mexico, Korea, Philippines, Australia and New Zealand and none is required at the present time for feed import to China (Taiwan). Several other importing countries (e.g., UAE, Costa Rica) have no government approval process so regulatory approvals per se cannot be obtained at this time.

With the exception of the specialty livestock market sector (e.g., organic, grass fed, or GE free), most Asian producers are currently importing and feeding other Roundup Ready and GE trait feedstuffs to their dairy and livestock. This includes corn, cottonseed, soybean and several other GE products, primarily for livestock feeds. Roundup Ready alfalfa does not differ substantially from these other products. However, importers have indicated that between 10 and 20% of Japanese consumers do not want GE traits in their animal feeds, and thus the presence of the Roundup Ready alfalfa creates issues for some importers and distributors. Exporters have not widely reported sensitivities from other importing countries.

Market Sensitivities of Export Buyers. Although there are no regulatory restrictions on the importation of Roundup Ready alfalfa into Japan or other major importing countries, export buyers have largely made decisions not to purchase Roundup Ready alfalfa since its inception in 2005. Some have stipulated in their contracts that the hay be non-GE. Importers have generally rejected Roundup Ready alfalfa (or at least expressed preferences for non-GE alfalfa). Since organic hay production represents less than 1% of the U.S. hay production, the export market is likely the largest segment of alfalfa hay production that is sensitive to the GE trait, by volume and value. Specific regions, such as the Columbia Basin of Washington and the Imperial Valley of California are particularly affected.
These business decisions may be due to the stated preference or unpredictability of their consumers (e.g., Japanese dairies) that may reject GE crops, combined with logistical considerations (inability to segregate lots for specific GE sensitive markets) in the distribution channel. Since export hay is subject to many aspects open to negotiation (hay quality, weeds, faults), the presence of GE traits is simply one additional point for negotiation. Importers may see it as a nuisance since they may have to segregate GE lots due to the fact that some of their customers do not want it. Although no hay shipment rejections due to the GE trait have been publicized (June, 2008), hay producers who produce for the export market fear that shipments could be rejected, at great cost to the exporter, if the GE trait is found in their hay. It should be pointed out that there have reportedly been some exports of Roundup Ready hay to Japan since 2006, and that this attitude may change over time. From a producer's point of view, and from a regional point of view, producers of alfalfa hay for export are concerned that importers may penalize their region and favor other regions (e.g., Canada, Australia) if importers believe that GE alfalfa may contaminate hay lots.

Due to the sensitivity of their markets, producers who produce for export have expressed concerns about the potential for contamination of non-GE export hay lots with Roundup Ready alfalfa, and its potential negative effects on their markets. Methods to assure the non-GE status for the purposes of market assurance are available, and several of these (e.g., testing hay lots) are being currently practiced by some exporters.

Routes to Contamination

There are four possible ways that the Roundup Ready trait could occur as a contaminant (adventitious presence (AP)) in conventional hay for export. These could be from seed co-mingling during planting of a hay crop, pollen flow during hay production, rotation of a GE sensitive crop after production of a GE alfalfa crop, and inadvertent mixing of GE alfalfa and conventional hay during harvest, transportation and storage. Of these, seed contamination and the possibility of mixing hay lots are clearly the most likely routes to contamination (and the most easily addressed). Adventitious presence due to pollen flow and crop rotation problems are less likely sources of contamination due to a range of biological factors.

Presence of GE Alfalfa Seed Intermingled with Conventional Seed at Planting. For hay producers, this is clearly the most likely route by which GE alfalfa can contaminate a field that is otherwise non-GE. Thus, the most important step a hay producer can take is to choose seed which does not contain the trait. GE sensitive hay producers should obtain seeds of a known conventional variety from a reputable supplier who uses best practices methods to mitigate AP of GE in their seed products. Prior to use, planting equipment should be cleaned and free of any unknown alfalfa seeds. It is also recommended that seed for planting be tested for the GE trait prior to planting, either by the seed company or the producer. Techniques are available to test alfalfa seed before planting to assure non-GE status of newly-planted crops, using commercially-available test strips. This is a low-cost method of assuring the establishment of a non-GE alfalfa crop.

GE Adventitious Presence in Hay Resulting from Gene Flow. There are a wide range of environmental barriers that make gene movement from neighboring GE alfalfa fields (or from feral plants) into a forage field very unlikely (Putnam, 2006). Synchrony of flowering between a conventional alfalfa field and GE alfalfa source must occur, and pollinators must be present during flowering, but there are many other barriers as well. The biggest barrier to AP contamination from GE alfalfa is the timing of forage harvest prior to significant flowering, pollination, seed set and seed ripening, a process which takes many weeks after a normal alfalfa hay harvest. Alfalfa managed for hay is usually cut at early flower (e.g., <10% bloom) and ripe seeds are not typically present in hay fields. GE sensitive hay producers should manage their hay cutting schedule to intentionally avoid ripe seeds throughout the field. This is especially true for export hay where premium pricing for high quality forage is a driving component in hay management. For gene flow to contaminate a hay field, seeds must be produced, fall to the ground, germinate, and contribute yield to the subsequently harvested field. Since hay fields are harvested frequently, and seed production is a rare occurrence in hay fields; this source of contamination is not particularly likely. Steps to minimize this possibility have been described (Putnam, 2006).

Volunteer GE Seedlings or Escapes from a Prior Crop. Volunteer alfalfa in a subsequent crop can occur. Therefore, if a GE sensitive field is planted after a GE alfalfa hay crop, these volunteers could affect the subsequent crop if not controlled. Techniques are available to do this. In practice, virtually all volunteers following an alfalfa hay crop are likely to be re-growths from existing plant roots, not seed which has germinated from seed produced from a hay field. The potential for GE seedling volunteers from a previous GE hay crop occurring in a conventional hay field are exceptionally small. This is different from the crop rotation dynamics following an alfalfa seed crop, since substantial quantities of seed are produced in seed fields, while either none or exceptionally small amounts of seed are produced from hay fields. Crop volunteers are a common problem in agriculture and occur with every species (e.g., wheat, oats, corn, soybean), whether GE or not. Volunteers are treated as weeds in a subsequent crop and controlled with tillage or with herbicides; there are herbicides available to control Roundup® resistant alfalfa. With alfalfa, agronomists recommend crop rotation with cereals such as corn or wheat, with 1-2 year separation between alfalfa crops (Canevari and Putnam, 2007), and do not recommend back-to-back alfalfa production due to problems with autotoxicity, diseases, nematodes, and weed populations. Crop rotation, combined with tillage and herbicides to control volunteer alfalfa is highly successful at removing existing alfalfa plants for subsequent crop production. In forage production research trials conducted in California and Washington, where the Roundup Ready alfalfa stand was terminated using a non-glyphosate herbicide and plow-down, there were no alfalfa volunteers emerging after the first year (Van Deynze et al., 2004). Normal crop rotations and crop plowdown accompanying a herbicide regime should take care of volunteer GE seedlings in subsequent crops in all but extremely rare situations. The production of GE sensitive alfalfa hay after the production of a GE seed or hay crop is a rare possibility, since 1) it is unlikely that a GE sensitive producer would have previously grown a GE crop, and 2) producers would most likely grow the GE sensitive crop on a field that has not previously produced a GE crop, as common-sense would dictate. However, methods to control volunteer alfalfa seedlings (from seed or remaining crowns) through herbicides, tillage, and crop rotation are available and well known to producers.

Physical Mixing of Conventional and GE Hay Lots. The possibility of mixing hay lots between GE and non-GE lots stands to be the most likely source of potential problems for hay export markets, in practice. However, methods to manage and segregate hay lots are also widely available to both producers and exporters. Exported hay is commonly sold in identity-preserved lots. Using a best practices approach for each lot, the origin of each lot is known from the time it leaves the field and farm to the time it arrives in a foreign port or it is blended into a manufactured product by a hay processor. This is frequently required by importers. Hay importers and the U.S. producers, brokers, exporters and feed processors are accustomed to providing extensive lot documentation to assure lot integrity. Lots are labeled and physically separated during storage and handling. Each lot is usually tested for forage quality and visually inspected for the presence of weeds or debris, etc. The National Forage Testing Association has careful lot identification as part of their hay testing protocol (http://foragetesting.org). This identification consists of a single cut from a single field of not more than 200 tons. Thus, it is relatively easy for export producers to provide documentation of hay lot identity using existing methods. GE sensitive hay handlers can opt to augment their routine practices to include supplemental GE mitigation steps such as GE trait testing; leaf and hay tissues may be tested for pre- and post-harvest quality assurance, respectively. Other best management practices are being used to effectively prevent accidental mixing of GE and conventional hay. Current hay export and lot identification practices should be effective in preventing inadvertent mixing of GE and conventional hay lots.

Testing to Provide Market Assurance

GE trait testing is readily available from private laboratories and kits can be used by individuals. The accuracy of the test method for hay was validated using both cored and ground forage samples from hay that was grown with different levels of adventitious presence (Putnam, 2006). Testing was shown to detect the presence of the Roundup Ready trait reliably at 1%, 5%, and 10%, and gave 0% positive readings at 0% AP, using two commercial test strips. It should be noted that 5% is the GE threshold at which some countries, such as Japan and Australia, require food to be labeled as containing approved GE traits. European markets require that food (not feed) over 0.9% GE be labeled as containing a GE product. However, hay is a feed and there are no such feed labeling requirements in any export market.

Coexistence Principles

Coexistence is not a new phenomenon in agriculture. For decades, it has been a requirement for many producers of crops, such as sweet corn and canola, in situations where neighboring crops may affect marketability of a specific quality trait. Scientific data and decades of experience in the seed and hay industries are the appropriate basis of coexistence and stewardship programs that are responsive to changing agricultural markets. Coexistence is based on good communication and mutual respect between neighbors and individuals who have adopted different approaches to agriculture. Furthermore, producers serving GE sensitive markets must understand contractual quality specifications and their ability to deliver to deliver those specifications to their customers (CropLife, 2006; SCIMAC, 2006; Sundstrom et al., 2003; Woodward, 2006). Likewise, the producer-licensees and licensors of GE varieties must understand and observe GE variety stewardship requirements. Science and process-based principles, combined with the availability of tools for monitoring and communication, are the keys to producing alfalfa for diverse markets. The U.S. hay export business is a well-developed industry that is amenable to addressing specialized contract requirements and has a proven history of successfully delivering quality products to an international customer base for decades.

Market Tolerances

In developing coexistence strategies, it must be acknowledged that commercial agricultural product purity is not absolute. Existing tolerances vary by customer preference. The Roundup Ready trait has been reviewed by the Food and Drug Administration (FDA) and has been found to be safe; that finding has not been disputed in the current regulatory review of Roundup Ready alfalfa. Thus, tolerances for low level presence should be considered in that context. Practical, acceptable low level tolerances for impurities such as variety off-types, weeds and inert materials have been established for many crop products and are managed within process-based strategies such as the Certified Seed (AOSCA, 2003) and the National Organic Program (NOP) (USDA, 2005a; USDA, 2005b). Tolerances of impurities (e.g., small amount of grass in lot) for export hay are primarily a question of market preference. Buyers and sellers determine the value of such hay in relationship to other quality classes of hay. To-date, there is no uniform tolerance established for low-level GE trait presence in conventionally grown crops (e.g., >5% and 0.9% GE in Japan and Europe respectively, must be labeled as such in food). GE trait sensitive markets are estimated to comprise less than 3-5% of the U.S. hay market (Putnam, 2006), consisting primarily of export producers, and secondarily of organic producers. Tolerance for low level presence driven only by market preference is likely to differ between the two markets. The implementation and refinement of protocols to enable successful coexistence between diverse production systems, recognizing differing market tolerances, are critical steps to assure alfalfa quality that is adequate for all primary markets for the crop.

Conclusions

Methods of assuring export customers of the non-GE status of both crop production and hay lots destined for export are available using current methodology. These steps are neither extraordinary nor expensive. This process includes the elements of:

- The planting of non-GE seed (including testing of seed) for fields destined for GE sensitive export markets;
- Taking steps to minimize the possibility of gene flow between fields through observation of flowering and harvest timing;
- Management of lot identity to assure status of non-GE hay lots destined for GE sensitive export markets;
- Testing of lots to assure customers of the non-GE status of hay lots.

It is suggested that state departments of agriculture, or crop improvement associations, or other industry entities (such as producer groups) may wish to provide public documentation of these processes, with accompanying certifications so that producers may serve GE sensitive export markets.

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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.

Thus, NAFA sponsored a national forum (2007) open to all alfalfa industry stakeholders to participate in the process of developing a coexistence plan. As a result of the forum, five documents have been created to guide a coexistence strategy for the alfalfa industry. Included among the five documents is a peer-reviewed publication describing the biology of alfalfa and alfalfa production in the U.S.; a comprehensive overview of gene flow in alfalfa and procedures to mitigate gene flow (CAST, 2008, in press). In 2008, NAFA adopted a document entitled, Best Management Practices for Roundup® Ready Alfalfa Seed Production (BMP's for RRA Seed Production). In acknowledgment of their commitment to the industry coexistence strategy, the three NAFA genetic suppliers formally adopted the BMP's for RRA Seed Production. In tandem, NAFA adopted three companion documents to address coexistence issues in each of the GE sensitive market sectors: hay export, seed export and organic alfalfa. Collectively, these five documents are essential tools toward enabling successful coexistence.

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